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REPORT ON MARS, NO. 29.

By WILLIAM H. PICKERING.

Introduction.

The apparition of Mars in 1922 was noteworthy in that at the time when the planet was nearest to the earth, on June 18, it was nearly as far south of the equator as it is possible for it to be. It was then in declination —26°.1, or 2°.7 south of the ecliptic. While it was then nearer to us than it had been for thirteen years, yet its southerly position greatly interfered with the work of all the northern observers. Although I had requested aid to the extent of only a few hours time from all of the great southern observatories, yet oddly enough we did not receive a single observation of this remarkably favorable apparition from any station south of the equator. This total lack of interest among the professional astronomers well illustrates one of the difficulties with which the compiler of Martian information has to contend. The opposition occurred on June 10, diameter of the planet 20″.30. On account mainly of the eccentricity of its orbit, it was nearest to us eight days later, an unusual amount. Its diameter then reached 20″.53. At opposition the solar longitude ☉ was 171°.26, corresponding to the Martian Date of September 21, which is 15 days before its equinox.

The designations, location, and equipment of the various observers who reported are as follows:

M. Dr. M. Maggini, Catania, Sicily. 13-inch refractor by Merz. Magnification 430 and 600. Seeing on Standard Scale ranging from 9 to 11.

P. Professor W. H. Pickering, Mandeville, Jamaica, B. W. I. 11-inch refractor by Clark. Magnification 330 and 430. Seeing on Standard Scale ranging from 6 to 10.

D. Professor A. E. Douglass, Tucson, Arizona. 8-inch refractor by Clark. Magnification 175 and 350. Seeing on Standard Scale 7 to 8.

W. L. J. Wilson, Esq., Nashville, Tennessee. 11-inch reflector by himself. Magnification 250 to 400. Seeing on Standard Scale 6 to 8.

R. P. M. Ryves, Esq., Teneriffe, Canary Islands. 10-inch reflector by With. Magnification 210 and 300. Seeing on Standard Scale 3 to 7, but sometimes momentarily reaching 10.

N. K. Nakamura, Esq., Kyoto, Japan. 7-inch refractor by Zeiss and 4-inch by Heyde. Magnification 230 and 130. Seeing on personal scale 5 to 8.

S. R. Schofield, Esq., Kobe, Japan. 8.5-inch reflector by Calver. Magnification 235 to 395. Seeing on Standard Scale 6 to 9.

G. H. J. Gramatzki, Esq., Berlin, Germany. 6-inch reflector by himself. Magnification 140 to 270. Seeing on Standard Scale 7 to 7.5.

P. Professor W. H. Pickering in 1890 at Cambridge, Mass. 12-inch refractor by Clark. Magnification believed to be about 350 and seeing probably about 6.

TABLE I.

FUNDAMENTAL DATA OF THE FIGURES.

Fig.	Obs.	Aper.	Magn.	Seeing	1922	Reg.	Long.	ΔLong.	Lat.	Diam.	☉	M. D.
							°	°	°	″	°	
1	M	12.8	430, 600	11	July 2	A	0	0	+9.0	19.9	183.7	Sept. 42
2	P	11	430	6,8	June 2	"	354	— 6	4.1	19.7	167.0	" 13
3	"	"	"	9	July 9	"	3	+ 3	9.6	19.2	187.8	" 49
4	D	8	350	7,8	July 9	"	2	+ 2	9.6	19.2	187.8	" 49
5	M	12.8	430, 600	10	June 25	B	58	— 2	8.2	20.4	179.7	" 35
6	P	11	430	9	June 30	"	58	— 2	8.8	20.0	182.6	" 40
7	"	"	430, 330	10	Aug. 8	"	57	— 3	8.2	15.4	205.7	Oct. 22
8	D	8	175, 350	7	July 4	"	67	+ 7	9.2	19.7	184.9	Sept. 44
9	M	12.8	430	10	June 15	C	127	+ 7	6.5	20.5	174.0	" 25
10	P	11	430, 330	9,8	June 23	"	120	0	7.9	20.4	178.6	" 33
11	"	"	"	9	Aug. 2	"	119	— 1	8.9	16.1	202.0	Oct. 16
12	D	8	350	7,8	June 29	"	124	+ 4	8.7	20.1	182.0	Sept. 39
13	M	12.8	430	9	June 12	D	177	— 3	5.9	20.4	172.4	" 23
14	P	11	"	9	June 17	"	180	0	6.8	20.5	175.2	" 27
15	"	"	"	9,6	July 29	"	180	0	9.3	16.7	199.6	Oct. 12
16	D	8	175	8	June 18	"	196	+16	7.0	20.5	175.7	Sept. 28
17	M	12.8	430, 600	11	July 9	E	253	+13	9.6	19.2	187.8	" 49
18	P	11	430	10	June 14	"	240	0	6.3	20.5	173.5	" 25
19	"	"	430, 330	7	July 21	"	235	— 5	9.7	17.7	194.8	Oct. 4
20	D	8	175, 350	8	June 15	"	235	— 5	6.5	20.5	174.0	Sept. 25
21	M	12.8	430, 600	11	July 6	F	300	0	9.4	19.5	186.0	" 46
22	P	11	430	7,9	June 4	"	299	— 1	4.4	19.9	168.0	" 15
23	"	"	"	10,9	July 13	"	294	— 6	9.7	18.7	190.1	" 53
24	D	8	350	7,8	June 10	"	287	—13	5.5	20.3	171.3	" 21
25	W	11	250, 400	5,6	July 10	A	338	—22	9.6	19.1	188.4	" 50
26	"	"	"	6	July 9	B	27	—33	9.6	19.2	187.8	" 49
27	"	"	"	7,8	July 1	C	97	—23	8.9	20.0	183.2	" 41
28	"	"	"	6	June 26	D	145	—35	8.3	20.3	180.3	" 36
29	"	"	"	6	June 16	E	209	—31	6.7	20.5	174.6	" 26
30	"	"	"	7,8	June 15	F	263	—37	6.5	20.5	174.1	" 26
31	R	10.2	300	5,6	Aug. 8	A	6	+ 6	8.2	15.4	205.7	Oct. 22
32	"	"	"	—	June 29	B	60	0	8.7	20.1	182.0	Sept. 39
33	"	"	210	5	July 28	C	120	0	9.3	16.8	199.0	Oct. 11
34	"	"	"	3,4	July 23	D	188	+ 8	9.6	17.5	196.0	" 6
35	"	"	—	—	July 15	E	239	— 1	9.7	18.5	191.3	Sept. 55
36	"	"	210, 300	7	July 7	F	295	— 5	9.4	19.4	186.6	" 47
37	G	6	220	7	June 22	B	62	+ 2	7.7	20.5	178.0	" 32
38	"	"	140	7,5	May 29	F	305	+ 5	3.4	19.2	164.7	" 9
39	S	8.5	235, 310	8	June 11	B	58	— 2	5.7	20.3	171.8	" 21
40	"	"	245, 395	6,8	June 30	E	240	0	8.8	20.0	182.6	" 40
41	N	4	130	5	June 24	E	265	+25	8.0	20.4	179.1	" 34
42	"	7	230	5	June 25 1890	F	325	+25	8.2	20.4	179.6	" 35
43	P	12	350±	6±	June 28	A	1	+ 1	14	17.8	176.4	" 30
44	"	"	"	"	June 20	B	58	— 2	14	18.5	172.1	" 22
45	"	"	"	"	June 15	C	107	—13	13	18.9	169.3	" 17
46	"	"	"	"	July 14	D	194	+14	14	16.0	185.7	" 45
47	"	"	"	"	July 11	E	222	—18	14	16.4	184.0	" 42
48	"	"	"	"	May 25	F	300	0	9	18.8	157.9	Aug. 53

Description of the Drawings.

In Table I is given a statement of the main facts relating to the various drawings. The table is arranged as in previous Reports, the successive columns giving the number of the figure, the designation of the observer, the aperture of his instrument, the magnifications employed, the seeing on the Standard Scale, which is described in Report No. **9**, the date of the drawing, the region depicted, the longitude of the central meridian, its deviation from the desired standard, the latitude of the center of the disk, the angular diameter of the planet, the longitude of the sun as seen from Mars, and the corresponding Martian Date taken from Report No. **10**. The average date of the drawings was June 29, or 19 days after the opposition. This is about the usual interval, and coincides with that obtained at the previous apparition.

According to the plan adopted in the earlier Reports, the drawings of the principal observers are so arranged that all in the same horizontal row shall represent approximately the same longitude on the planet. In the vertical columns the longitudes are intended to differ by just 60°, beginning with longitude 0°. Thus six views of the planet are shown by each observer, covering the whole visible surface. The six regions are indicated by the letters **A**, **B**, **C**, **D**, **E**, and **F**. The other drawings are arranged on separate pages, and no further explanation of them is necessary.

The Work of the Different Observers.

We regret the absence this year of all the British observers excepting Mr. Ryves and Mr. Schofield from our list of contributors, but since the altitude of Mars when on the meridian as seen from London was only 12°.4, it is quite natural that little could be done there. Usually nearly half of our observations come from the British Isles. The two gentlemen mentioned observed in foreign countries. Curiously enough however, we have this year an enthusiastic and painstaking German observer in Berlin, who sent us three sketches, two of which we reproduce, because they appear to us to be extremely good, considering that the altitude of the planet as seen from that station never exceeded 12°, and in Figure 37 could not have been over 11°. He even detected 6 of the more prominent canals, and only drew one that was not confirmed, and probably was not there. He employed a 6-inch reflector made by himself, which it is believed was as large an instrument as the seeing at that altitude would have borne.

The next most northern observer was Dr. Maggini at Catania, Sicily, latitude 37°.5. That he should have seen as many canals as are indicated in Tables II and III, including six double ones, with an altitude of Mars never exceeding 26°.5 is certainly surprising. The large number of canals, and also of lakes which he saw (see Tables III and VI) which could not be confirmed by other observers better located, is of course regrettable, nevertheless he saw many canals which others did confirm. We never attempt to observe the planet ourselves at a lower

altitude than 35°. Our latitude is 18°, giving us at this opposition a maximum altitude for the planet of 46°. The latitudes of four of the other observers ranged between 32° and 36°.

Ryves obtained a very good series of drawings from the island of Teneriffe in the Canaries, latitude 28°, with his 10-inch reflector, which he took there for that purpose. Maximum altitude of the planet 36°. The island lies some 300 miles south of Madeira, whence Green with a 13-inch reflector in 1877 obtained his classic series of drawings. Incidentally it may be remarked that Ryves saw a good deal more detail than Green, but had of course the great advantage of knowing that the canals were there, which Green did not. He states that his altitude was 7700 feet, and that he was located on dry volcanic ash. There was considerable wind from the northwest. Only about two nights per month were cloudy during his stay. Cumulus clouds were almost constantly seen below him. The seeing was "characterized by general unsteadiness, with frequent but brief moments of marvelously good definition". The numbers in Table I do not, he says, give a fair idea of his best moments.

Wilson also obtained some excellent drawings from his station in Nashville, Tennessee. Unfortunately all of them differed so greatly from the required Martian longitudes, in which drawings were secured by the other observers, that comparison with their work is unsatisfactory. The drawings are very useful however for statistical purposes, and for this reason we have reproduced all six of them. We have received drawings from two observers in Japan. They had rather small instruments, but their work appears to have been done with care, and is of additional value coming from a terrestrial longitude which permitted them to observe the different Martian longitudes at a time when they were invisible to European and American observers.

In connection with the fact that no southern observatory obtained any observations of Mars whatever, as far as we are aware, and that many of the usual northern observers were excluded by their high latitudes, it may be mentioned that as it turned out, this was by far the most interesting and instructive apparition that we have observed hitherto. Nor do I exclude in this comparison the somewhat nearer one of 1924. The reason for this appears to be that in 1922 Mars was in a portion of its orbit where rapid seasonal surface changes were very marked, and some of the things that were observed to actually occur are extremely difficult to explain. No matter how diligent the observers, at no single observatory can they expect to see even one-third of all the interesting rapid changes that occur during any given apparition. It is therefore the more to be regretted that no accurate observations appear to have been secured at any station south of our own.

Between May 19 and 26, ⊙ 159°.3 to 163°.0, corresponding to early September on Mars, the surface of the planet was densely clouded, so that the appearance of even the most prominent details was transformed, the dark regions being outlined only in part by the deserts,

PLATE III.

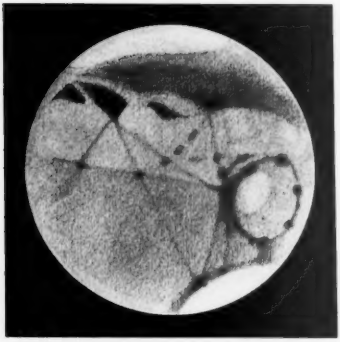


Fig. 13
Maggini 177° D

Fig. 14
Pickering 180° D

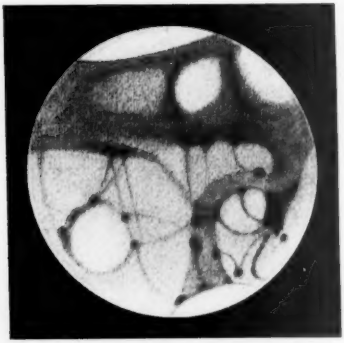


Fig. 17
Maggini 253° E

Fig. 18
Pickering 240° E

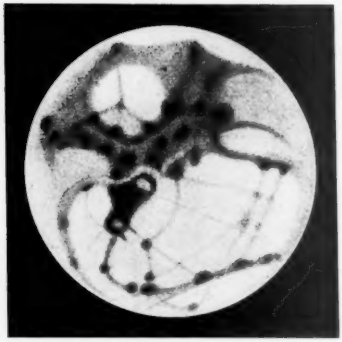


Fig. 21
Maggini 300° F

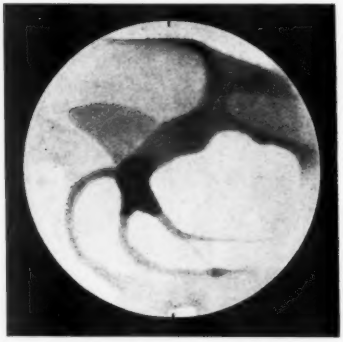


Fig. 22
Pickering 299° F

DRAWINGS OF MARS IN 1922.

POPULAR ASTRONOMY, No. 323.

PLATE IV.

Fig. 15
Pickering 180° D

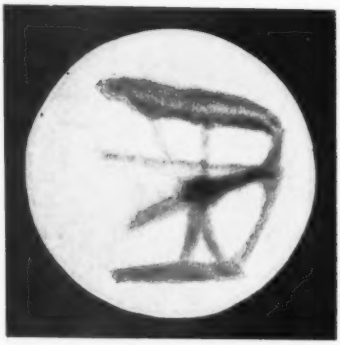


Fig. 16
Douglass 196° D

Fig. 19
Pickering 240° E

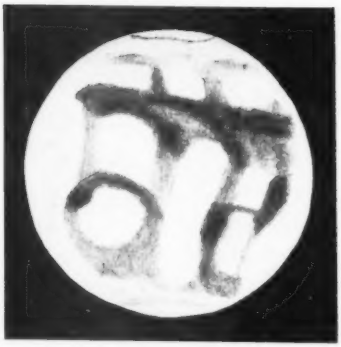


Fig. 20
Douglass 235° E

Fig. 23
Pickering 294° F

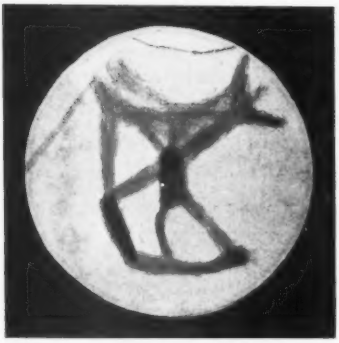


Fig. 24
Douglass 287° F

DRAWINGS OF MARS IN 1922.

and in part by Martian clouds. What detail could be seen was extremely faint and hazy, the haze covering the equatorial regions rather than the extreme north or south. Only short sections of the canals surrounding Elysium were visible, Lunae was extensive but very faint, while the outlines of Thaumasia were in large part covered by cloud, giving it a very unusual apparent shape. Owing for the most part to unfavorable terrestrial weather conditions which not infrequently occur in our rainy seasons, no observations were secured here between May 9 and 19, nor between May 26 and June 2. The Martian cloudy spell may therefore have lasted three weeks, but we are only sure that it lasted one.

In order to illustrate the more striking changes in the markings themselves, and also their development, as well as the disappearance of some of the canals, we have given two series of drawings that were secured here in the period extending from June 2 to August 8. It will be remembered that the planet was nearest to us on June 18, so that in the nearest drawing made in the second set it was more remote than in the most distant drawing made in the first. By referring to Table III in the third and fourth columns, it will be seen that in the drawings made while the planet was near us only 41 canals were seen, while in those made when the planet was more remote 48 were visible. Of these latter, 5 were detected which were not confirmed elsewhere, probably because they had developed too late to be found in the drawings by the other observers, which were all made earlier in the apparition. Only 30 canals were common to the two sets. Similar results were obtained with the lakes.

The reader should fully appreciate the fact that the differences between these two series are not due to bad drawing. They are given for the very reason that they do differ so strikingly from one another, and to illustrate the marked changes that occur at this season of the Martian year. Usually drawings made in successive months by the same observer resemble one another very closely. In the present case Figure 2 differs markedly from Figure 3. The latter was drawn on the same night as Figure 4 by Douglass, and a week later than Figure 1 by Maggini. It resembles these two drawings much more than does Figure 2, which was drawn five weeks earlier, before the detail had developed. On the other hand Figure 22 resembles Figure 24 by Douglass, while Figure 23 resembles Figure 21 by Maggini. The two former were drawn about a week apart, and the two latter a month later, also a week apart. A difference between the maria in Figures 10 and 11 is due to the fact that in the latter the region of Titanum was concealed by terminator cloud. Titanum itself was clearly visible the previous night, so that the change in this case is only apparent, not real.

These rapidly changing appearances will perhaps best illustrate to the reader why Martian observers find the planet so interesting to sketch, whenever it is near us, and why a comparison of its meteorol-

ogy and vegetable life with our own offers such a fascinating field for research. These exceptionally cloudy spells and rapid changes of detail are found to occur just before, and at the time of the Martian equinoxes, both spring and autumn. Then also the canals are fewest, being least developed. At these times the northerly winds of the planetary circulation give place to the southerly ones and *vice versa*. In other words then the vernal polar cap begins to melt, and transfer its moisture across the surface of the planet towards the autumnal one, which soon after begins to form.

While just preceding the summer solstice of the southern hemisphere, which we passed in 1924, when the diameter of the planet was over 25″, more canals were visible than at the equinoxes, yet it is during the summer solstice of the northern hemisphere and before it, when the diameter scarcely exceeds 15″ that the most conspicuous canals are visible. Then is the time when the amateur, furnished with a small telescope, can most readily see them. Indeed in February, 1916, when the diameter was less than 14″, both Thoth and Nilosyrtis were clearly seen here with a 3-inch aperture (Report No. **15**, 4).

Finally, in describing the various drawings included in this paper, I may refer to the last series represented, which consists of a set of drawings, never before published, that the writer made in Cambridge, Mass., with a 12-inch refractor in the year 1890. In that year the position of the planet in its orbit as indicated by the solar longitudes ⊙ was nearly the same as in 1922. Figure 43 resembles Figure 2 of the first set of our later drawings perhaps rather more nearly than it does Figure 3 of the second set. Oddly enough, considering the poor seeing in Cambridge, it shows more canals than either of them, thus illustrating the fact that seasons on Mars differ in this respect. Figure 44 most resembles Figure 7 of the second set, while Figure 45 is more like Figure 10 of the first. Figure 46 most resembles Figure 15 of the second set, and again shows many more canals, but probably owing to atmospheric conditions, is I am afraid not a very good representation of the shape of the detail that was really visible at that time. Figure 47 bears little resemblance to either Figures 18 or 19, but curiously enough looks much more like Mr. Wilson's Figure 29, drawn with about the same central meridian. Evidently he and I saw things very much alike in these two different years. Figure 48 looks little like any drawing of the Syrtis Major made of late years, but when we compare it with Figure 22, as distinguished from Figure 23, and consider that the larger loop in all three figures is identical, we see that the two earlier ones clearly represent a transition stage not long maintained, and therefore seldom seen. Ryves also shows it in Figure 36, and Douglass to a certain extent in Figure 24. The others seem to have missed it. It is thought that these three series of drawings, made by the same observer, at the same Martian season, and at an extreme interval of 32 years, may have some interest, and are perhaps unique. The early ones represent the best results of 32 nights of observation. The planet only

reached an altitude at Cambridge that year of 25° at opposition, so that we see that even in New England, where we get perhaps the worst seeing in the United States, if not in the civilized world, the canals of Mars can occasionally be seen, and drawn with some accuracy. In an earlier paper I once expressed doubt as to their visibility from Cambridge, but by Table III we see that 34 were detected there, which is really not a bad record at all, and of these, 29 were confirmed in 1922. I may perhaps add that at that time I was unfamiliar with Schiaparelli's maps, although the existence of the canals was of course well known to me.

Description of the More Important Changes.

In general the observers made few remarks on their observations. Professor Douglass mentions the conspicuous white area that appeared south of Margaritifer on July 9. He states that it had moved northward on the 10th, and had then nearly disappeared. Mr. Ryves says "Amongst the most interesting features I should specially mention the shape of Syrtis Major." To this we have just referred. He further mentions "the prominent canal running down the 240th meridian (Aethiops?), the prominence of Solis Lacus which I saw disconnected from Sinus Aurorae, the brilliant white spot in about 340°, —60°, on July 8 and 9, strength of the Nepenthes system, and of that of Trivium Charontis, Cerberus." Mr. Wilson records that Amenthes was first visible June 15, and not on June 11. He mentions a dark chocolate-colored spot in longitude 46°, latitude —35°, visible on July 6. This spot was not seen here, nor was any noticed near that place on July 7 or 8, but on July 9 a round dark area appeared near longitude 15° latitude —25°, which shortly developed into a conspicuous white spot. Our own observations of this spot, and of certain other markings visible at this apparition, are so detailed and extensive that they must be deferred until our next report.

Before closing this section however, a few words may be said regarding certain cloud formations which were observed, projecting beyond the limb and terminator from the northern polar cap (See Figures 7, 11, 15, and 19). Such projections appear only at rare intervals. They were first seen on the terminator in 1892, under similar conditions to those of the present apparition, both at the Lick Observatory and at Arequipa. At the latter station we also saw projections on the limb, and measured their height, with our 13-inch telescope. It is recorded that they "attained an altitude of at least 20 miles" (*Astronomy and Astrophysics,* 1892, **11**, 849). No limb projections have been seen from that day until this apparition, as far as the writer is aware. The first one that we saw in 1922 appeared on June 22, 23, and 24, north of Elysium, ⊙ 178°.0 to 179°.2, corresponding Martian Dates September 32, 33, and 34. The next one appeared July 10, and after that they were visible on practically every favorable night until August 16, ⊙ 210°.5, Martian Date October 30, after which

no more were seen. They were recorded on 17 nights in all. None of the other observers mention them, but it is possible that they may have been seen elsewhere.

The two highest appeared on June 22 and July 10, and each projected 0″.25 ± 0″.05 above the limb, as measured by means of our Scale of Projections. The principle of this scale is described in Report No. **7**. These measures were corroborated by drawings made at the time. It was concluded further that an altitude of less than 0″.1 would be likely to pass unnoticed. Reducing these measurements to miles, we find that they correspond to altitudes of 50 and 55 miles respectively. These results seem very high, but it is thought that they cannot be much reduced, for the projections were very conspicuous, as is shown in the figures. They rarely equalled 2″ in length, and always appeared over the polar cap, and usually near its southern border. Their latitude ranged from 45° to 80°, but in the latter case the cloud was apparently seen across the cap. Four different projections, or about one-third of them, originated near longitude 220°, south of Elysium. The others were scattered fairly uniformly around the pole. At the previous apparition in 1920 Mars was too remote at the proper season for us to detect them. In 1924 the planet was near us, but none were seen.

On account of the small value of the surface gravity on Mars, clouds in a similar atmosphere would rise to 2.6 times the height that they would with us. Now our thunder-storm clouds sometimes reach an altitude of 7 miles. Under similar conditions on Mars they would rise to 18 miles. Under different conditions, which may well obtain there, less dense clouds might very well rise to the heights that we have recorded. This would seem to imply however a much more dense and extensive atmosphere than has heretofore been generally assumed, possibly one fully as dense as our own.

The northern polar cap itself was very small in May, but increased rapidly to a maximum in early July, corresponding to the end of the Martian September. It then had a radius of practically 45°. Its disappearance was fully as rapid, and by September 20, Martian Date November 9, its radius was reduced to 10°. After that it again increased, disappearing and reappearing throughout the remainder of the year. Its brightness ranged from 7 to 9, never reaching 10. The tops of the projecting clouds were the brightest portions, thus indicating greater freedom from the absorption of the surrounding atmosphere, at that considerable elevation. On account of its comparative faintness, and of its striking and rapid changes in size and shape, it is believed that this cap was composed entirely of cloud. A very similar cap was observed in 1920, when it reached its maximum size on the Martian Date September 36. It disappeared finally on the Martian November **3.**

PLATE V.

Fig. 25
Wilson 338° **A**

Fig. 26
Wilson 27° **B**

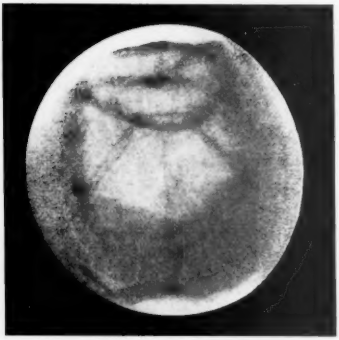


Fig. 27
Wilson 97° **C**

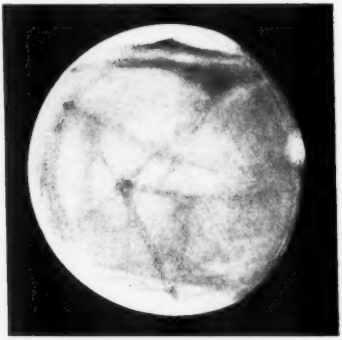


Fig. 28
Wilson 145° **D**

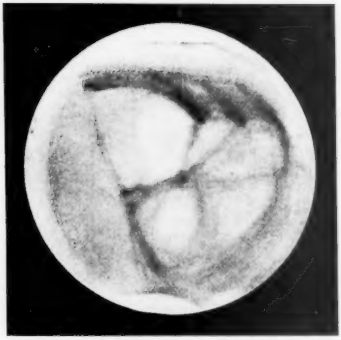


Fig. 29
Wilson 209° **E**

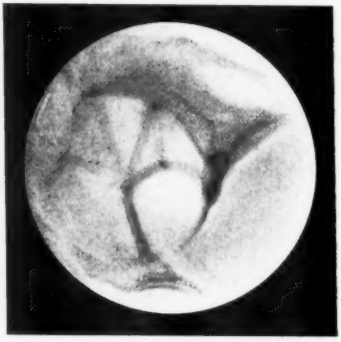


Fig. 30
Wilson 263° **F**

DRAWINGS OF MARS IN 1922.

PLATE VI.

Fig. 31
Ryves 6° **A**

Fig. 32
Ryves 60° **B**

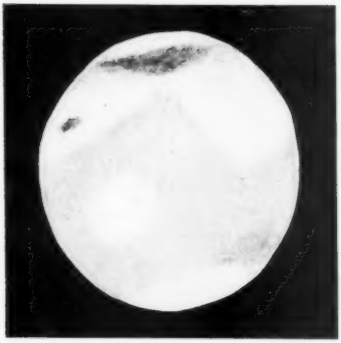


Fig. 33
Ryves 120° **C**

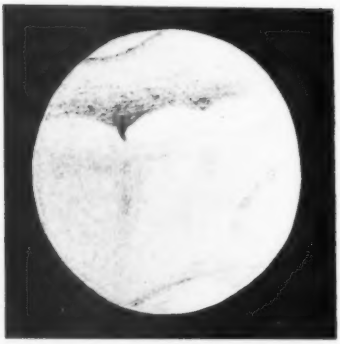


Fig. 34
Ryves 188° **D**

Fig. 35
Ryves 239° **E**

Fig. 36
Ryves 295° **F**

DRAWINGS OF MARS IN 1922.

STATISTICS OF THE CANALS AND LAKES.

In Table II the canals seen by the different observers are arranged in alphabetical order, the headings of the ten following columns give the abbreviations of the observers' names, and the columns themselves give the letters which indicate on which drawings the canals are to be found. These letters are given in Table I, and also under the drawings themselves. In the last column is given the number of observers, including only the first six through Ryves, who saw each canal. In some cases no canal is found on our standard map which can be identi-

TABLE II.

CANALS IDENTIFIED IN THE DRAWINGS.

No.	Canals	M	P	P	D	W	R	N	S	G	P	Obs.
1	Abalos				B							1
2	Acampsis L			C								1
3	Acheron	C			C							2
4	Aesacus	D									E	1
5	Aethiops	E	E		E	F	E	E				5
6	Alcyonius		E		E	E	E	E				4
7	Alpheus	F										1
8	Ambrosia L	B				C						2
9	Amenthes	E	E		EF	EF	F	E				5
10	Anian	D			E						E	2
11	Araxes	BC	C	C	C	C	C					6
12	Arius D	E										1
13	Aroeris	F										1
14	Astaboras	F	F	F	F		F					5
15	Astusapes	F		EF								2
16	Ausonium				F	F						2
17	Avernus	D										1
18	Baetis	B	B									2
19	Bathys D				C	C						2
20	Bias L '09	F										1
21	Borcas		D		D						DE	2
22	Boreosyrtis										F	0
23	Brontes	C		D		DE	D				D	4
24	Cadmus	F										1
25	Callirrhoe		A		A							2
26	Cantabras D	A										1
27	Casius	EF	F	EF							F	3
28	Catarrhactus L	B	C	BC								3
29	Cerberus	DE	DE	DE	DE	E	DE		E		DE	6
30	Ceraunius		C			CD						2
31	Chaos	DE	DE	E	E	E	E		E		E	6
32	Chrysorrhoas	B		BC	B	C	B				C	5
33	Cliter L '09	C										1
34	Coprates D	B	BC	BC	B	C				B		5
35	Cyclops				D	E			C		E	2
36	Daemon L	B	BC	BC	BC	C	BC					6
37	Daradax L	A										1
38	Dardanus	A				B	B					3
39	Dargamanes (*d*) L	B										1
40	Deuteronilus	F	AF	ABF	A	A	A	F			A	6
41	Diagon (*d*) L				F							1
42	Djihoun L										A	0
43	Doseron (*d*) L				F	F						2
44	Erebus				D	D		E			DE	2
45	Eumenides	CD	D	C	C	D						5

TABLE II.—CONTINUED.

CANALS IDENTIFIED IN THE DRAWINGS.

No.	Canals	M	P	P	D	W	R	N	S	G	P	Obs.
46	Eunostos	DE	E	E	E	E	E	E	E		E	6
47	Euphrates	AF			A			F			A	2
48	Euripus				E							1
49	Evenus					D						1
50	Fortuna	B				C						2
51	Galaxias				D							1
52	Ganges	B		B	B	BC	B		B	B	B	5
53	Gehon	A		A	A	AB		F			A	4
54	Gigas	CD	C		C	CD						4
55	Gyndes	D	E			D	DE		E			4
56	Hades	D			D	D						3
57	Heliconius	E					E		E			2
58	Hephaestus	E										1
59	Hyblaeus	DE	E	E	E	E	E	E	E		E	6
60	Hydaspes	A										1
61	Hydraotes	B										1
62	Iaxartes	A				B						2
63	Ich L			C								1
64	Indus	AB	B	B	B			F		B	A	4
65	Iris	C		C	C	D						4
66	Issedon	B		B	B							3
67	Ister D	F		F				F				2
68	Jamuna	B										1
69	Japhyx L					F						1
70	Jordanis				A							1
71	Kedron P		B		BC	C						3
72	Laestrigon	D			DE		D				DE	3
73	Lethes		E	E								2
74	Lycus					D						1
75	Marne P				D		D		E			2
76	Nar L			F							E	1
77	Nasamon	EF	E	E	EF			EF				4
78	Nectar	B	BC	BC	B	C			B		BC	5
79	Nepenthes	EF	EF	E	EF	F	EF				F	6
80	Neudrus	A			A							2
81	Nicenus D	E										1
82	Nilokeras	AB	B	BC	B		B			B	B	5
83	Nilosyrtis	EF	F	EF	EF	F	F	EF	E	F	AF	6
84	Nilus	B								B		1
85	Orcus	D	D	DE		DE						4
86	Orontes	A										1
87	Orosines (*d*) L				F	F						2
88	Oxus	A	A	A	A	B	A	F				6
89	Pactolus	E	E	E		EF					E	4
90	Pallas D					F						1
91	Pandora	AF	A	AF	AF					F		4
92	Peneus	F										1
93	Perseus L	C										1
94	Phasis				C							1
95	Protonilus	F	AF	F	F		F	EF			AF	5
96	Pyriphlegethon	C	D	C		CD						4
97	Sados L			F								1
98	Sirenius	C		C								2
99	Siris	A				B						2
100	Sitacus	AF		A	A			F			A	3
101	Styx	DE	DE	DE	DE	E	DE		E		DE	6
102	Tanais	A			B						C	2
103	Tartarus	DE	D	D	D	DE					D	5
104	Thoth	EF	EF	EF	EF	EF	EF	E	E		F	6

TABLE II.—CONTINUED.

CANALS IDENTIFIED IN THE DRAWINGS.

No.	Canals	M	P	P	D	W	R	N	S	G	P	Obs.
105	Titan	D									D	1
106	Triton	E	E			F					F	3
107	Typhonius	F					F					2
108	Uden L	C		C	C							3
109	Udon D	EF										1
110	Xanthus				E							1
111	Anon. *(a)*	A										1
112	Anon. *(b)*	A										1
113	Anon. *(c)*	A										1
114	Anon. *(d)*	A	A									2
115	Anon. *(e)*			C								1
116	Anon. *(f)*				C		C					2
117	Anon. *(g)*					D						1
118	Anon. *(h)*	E										1
119	Anon. *(i)*			F	F							2
120	Anon. *(j)*							F				0
121	Anon. *(k)*		E	F								2
122	Anon. *(l)*			F								1

fied with the ones observed. In such cases the name of the canal is followed by a capital letter, L for Lowell, D for Jarry-Desloges, and P for the writer. The letter L refers to a map in Vol. **3** of the *Annals of the Lowell Observatory*, Plate XI, unless it is followed by '09, in which case it refers to an unpublished map by Lowell based on his observations of 1909. The map by Jarry-Desloges is found in his third volume. Of the two canals named by the writer, Kedron will be found described in Report **17**, 8, and Marne in Report **21**, 7. The (*d*) placed after certain of Lowell's canals indicates that they are found in the dark regions or maria. The twelve canals that were seen and were previously unnamed, may be described as follows:

(a) Preceding Neudros.
(b) Following Neudros.
(c) An east and west canal south of Pandora.
(d) A canal bounding Thymiamata on the south.
(e) A canal extending northwest from Phoenicis, between Iris and Pyriphlegethon.
(f) A canal extending northwest from Sirenum.
(g) A canal between Biblis Fons and Eleon Lacus of Lowell.
(h) A small canal between Casius and Nasamon.
(i) A canal joining Caloe to Nuba.
(j) A canal north of, and parallel to Protonilus.
(k) A canal bounding Hellas on the west.
(l) Its western component.

Information regarding the number of canals recorded by each observer is contained in Table III. When a canal was seen by all six of the first observers we may describe its visibility as 6. When seen by only five of them, its visibility is 5, and so on. The first column of the table records the visibility, and the remaining columns the number of canals of each visibility seen by each observer, and the total number

TABLE III.

THE NUMBER OF CANALS RECORDED.

Obs.	M	P	P	D	W	R	Total	N	S	G	P
6	12	12	12	12	12	12	12	6	7	1	9
5	11	9	9	11	8	7	11	3	2	3	7
4	11	10	10	8	10	3	13	4	1	2	3
3	9	3	5	5	3	2	9	1	0	0	4
2	15	7	7	15	10	4	29	3	3	0	6
1	27	0	5	8	6	0	46	1	0	1	3
0											2
Total	85	41	48	59	49	28	120	18	13	7	34
Confirmed	58	41	43	51	43	28	74	17	13	6	29

seen by all. Thus Maggini and Douglass were the only observers who saw all the canals of visibility 5. The next to last horizontal row of figures gives the total number of canals seen by each observer, and the last row the number of his canals that were confirmed by at least one other person. Thus as in former years Maggini saw a great number of canals, but only 58 of them were confirmed by others. For the other observers the two figures agreed more nearly. At this apparition a total of 74 confirmed canals were seen, showing as was predicted a distinct falling off from the last apparition when 86 were visible.

TABLE IV.

PROPORTION OF THE CANALS VISIBLE TO THE DIFFERENT OBSERVERS.

Vis.	M	P	P	D	W	R	Total	N	S	G	P
6	1.00	1.00	1.00	1.00	1.00	1.00	12	.50	.58	.08	.75
5	1.00	.82	.82	1.00	.73	.64	11	.27	.18	.27	.64
4	.85	.77	.77	.62	.77	.23	13	.31	.08	.15	.23
3	1.00	.33	.56	.56	.33	.22	9	.11	.00	.00	.44
2	.52	.24	.24	.52	.31	.14	29	.10	.10	.00	.21
1	.51	.00	.11	.17	.13	.00	46	.02	.00	.02	.07
Confirmed	.78	.55	.58	.69	.58	.38	74	.24	.18	.09	.39

In Table IV the arrangement is similar to that in Table III, except that instead of giving the total number of canals seen by each observer, it gives the proportion of the total number recorded. These total numbers are given in the eighth column, and are taken directly from Table III. As we descend the columns to fainter and fainter canals, the proportion of the total number seen by each observer should gradually decrease, falling off sharply when he approaches his limit, and this we find in general to be the case, except for Maggini. The limiting visibility for any given observer may be taken as that at which he is able to see only about one-quarter of all the canals of that visibility. Thus for Wilson and the writer it seems to be about 2. This rule obviously does not apply to the observers from Japan and Germany, since only a portion of their drawings could be included. The last horizontal line of the table shows the proportion of confirmed canals that each observer contributed to the final result. It is deduced from the last row of Table III.

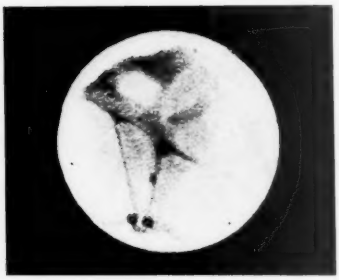


Fig. 37
Gramatzki 62° B

Fig. 38
Gramatzki 305° F

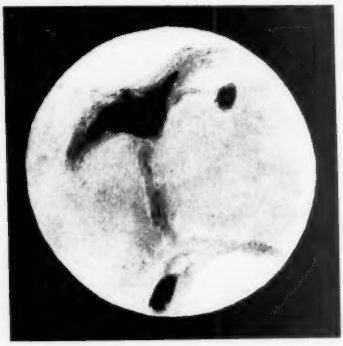


Fig. 39
Schofield 58° B

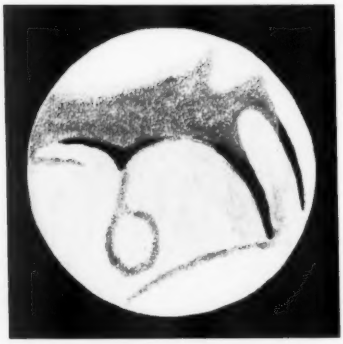


Fig. 40
Schofield 240° E

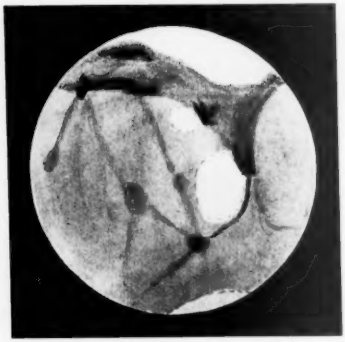


Fig. 41
Nakamura 265° E

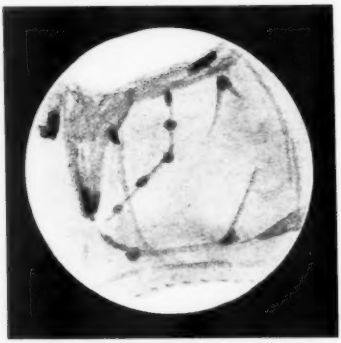


Fig. 42
Nakamura 325° F

DRAWINGS OF MARS IN 1922.

PLATE VIII.

Fig. 43
Pickering 1° **A**

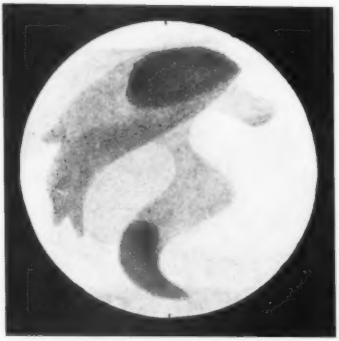


Fig. 44
Pickering 58° **B**

Fig. 45
Pickering 107° **C**

Fig. 46
Pickering 194° **D**

Fig. 47
Pickering 222° **E**

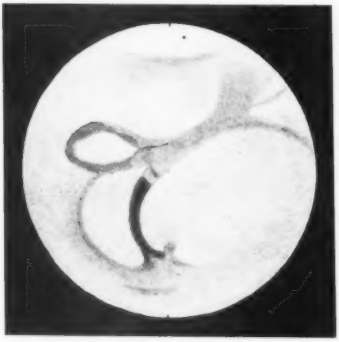


Fig. 48
Pickering 300° **F**

DRAWINGS OF MARS IN 1890.

TABLE V.

LAKES IDENTIFIED IN THE DRAWINGS.

No.	Lakes	M	P	P	D	W	R	N	S	G	P	Obs.
1	Acadenus L	A										1
2	Acidalius L	A		B								2
3	Ascraeus	C		C		C						3
4	Biblis L	C				D						2
5	Byce L					C						1
6	Castorius					D						1
7	Casuentus L	E				F						2
8	Charontis	DE	DE	DE	DE	DE						5
9	Caloe	F					F	F			F	2
10	Eleon L					D						1
11	Hecatis L					E						1
12	Ismenius	F	AF		AF		A	F				4
13	Juventae	B	B									2
14	Labeatis									B		0
15	Lunae	B		C		C				B		3
16	Maeisia L	B		C		C						3
17	Major L					F						1
18	Messeis L	B	B									2
19	Minor L	E				F						2
20	Moeris	EF				F						2
21	Niliacus					B						1
22	Nadus D	D		C		C						3
23	Nilus L	F										1
24	Novem L	A				B						2
25	Nuba	EF						E				1
26	Oxia	A										1
27	Pambotis	DE				E						2
28	Phoenicis	BC	BC	C	CD							4
29	Propontis		D	D								2
30	Protei L	A		B								2
31	Scotitus L	E										1
32	Semnon L	CD										1
33	Siloe L	A						F				1
34	Sirbonis	A						F				1
35	Tithonius L	B										1
36	Triton	EF				EF		E				2
37	Triviae L	DE										1
38	Utopia	CD										1
39	Anon. *(a)*	C		C								2
40	Anon. *(b)*	C	C									2

TABLE VI.

THE NUMBER OF LAKES RECORDED.

Obs.	M	P	P	D	W	R	Total	N	S	G	P
5	1	1	1	1	1						
4	2	2	1	2		1	2	1			
3	4		4		4		4			1	
2	14	5	4		7	1	15	2			2
1	11				6		17	3			
0										1	
Total	32	8	10	3	18	2	39	6	0	2	1
Confirmed	21	8	10	3	12	2	22	3	0	1	1

Tables V, VI, and VII for the Martian lakes are arranged precisely like the three for the canals. The only anonymous lakes entered in the tables are two that were confirmed, drawn by Maggini and the writer. His other numerous anonymous unconfirmed lakes need not be consid-

TABLE VII.

PROPORTION OF THE LAKES VISIBLE TO THE DIFFERENT OBSERVERS.

Vis.	M	P	P	D	W	R	Total	N	S	G	P
5	1.00	1.00	1.00	1.00	1.00	.00	1	.00	.00	.00	.00
4	1.00	1.00	.50	1.00	.00	.50	2	.50	.00	.00	.00
3	1.00	.00	1.00	.00	1.00	.00	4	.00	.00	.25	.00
2	.93	.33	.27	.00	.47	.07	15	.13	.00	.00	.15
1	.65	.00	.00	.00	.35	.00	17	.18	.00	.00	.00
Confirmed	.95	.36	.45	.14	.55	.09	22	.14	.00	.05	.05

ered here, and the other observers saw none that were anonymous. The two referred to are the most northern ones shown in Figures 10 and 11.

Mandeville, Jamaica, B. W. I., November 20, 1924.

THIRTY-THIRD MEETING OF THE AMERICAN ASTRONOMICAL SOCIETY.

The thirty-third meeting of the Society was held in Washington from December 30, 1924, to January 1, 1925, in affiliation with the American Association for the Advancement of Science. The headquarters for the Society were at the Hotel Powhatan, and such was the interest of the members in the astronomical program that, if it had not been for two joint sessions with other societies, they would have been almost unaware that there were present in Washington the largest number of scientists ever attending a meeting of the Association, more than four thousand being registered.

On Tuesday afternoon, at a joint meeting with the physicists held at the Bureau of Standards, there were main addresses by Vice-President W. F. G. Swann of Section B, "The Trend of Thought in Physics"; by Vice-President Heber D. Curtis of Section D, "The Equinox of 1950"; and by Professor V. Bjerknes, of the Geofysisk Institut, Bergen, Norway, on "Solar Hydrodynamics." These were followed by several papers from the regular program of the Physical Society. Tuesday evening was left open, and the members made good use of the opportunity for renewing acquaintances and talking shop among themselves.

On Wednesday, the Society spent the day as the guests of the U. S. Naval Observatory. In the morning our hosts sent busses with glass tops, quite appropriate for astronomers, for the trip from the hotel to the Observatory, where we were welcomed by the superintendent, Captain Edwin T. Pollock, U. S. N. Vice-President Brown presided over the sessions, which included a number of papers by members of the staff of the Naval Observatory. At noon a buffet luncheon was served in the hall of the main building, and members had until three o'clock for getting acquainted with the staff and surroundings of this center of activity in the "astronomy of precision." As an indication of the cordial coöperation between this government department and

astronomers at large, it was announced by Captain Pollock that special radio time signals would be sent out by the Naval Observatory thirty minutes before and after the total phase of the eclipse of January 24. The attendance at these sessions, as at the others when the astronomers were alone, was about one hundred and twenty-five. The members were returned to the hotel after a full and profitable day.

On Wednesday night occurred an event which was marked on the program and celebrated by a number of the faithful, and it will probably be remembered and noted long after other astronomical happenings of the current year are forgotten. At midnight was the change from astronomical to civil reckoning, as recommended some years ago by a committee of the Society to conform with the proposed practice of the principal national almanacs of the world. It was noted in Washington that there is already confusion as to what is meant by Greenwich Mean Time, or by midnight of say January 1, but American astronomers seem to be unanimous in approval of making the whole change and to use hereafter nothing but civil reckoning.

On Thursday morning in Corcoran Hall, George Washington University, was held another joint session, this time with the mathematicians and the physicists. It had been hoped to have Professor A. S. Eddington, of Cambridge University, to speak on the subject of "Stellar Evolution," but he had been called home to England. Professor Henry Norris Russell gave, therefore, a summary of both his own and Eddington's latest views on this subject. He was followed by Professor Archibald Henderson on a similar topic, "Is the Universe Infinite." These papers led to some lively discussion on the part of representatives of the different societies.

It was at this session that Professor Russell presented the communication by Dr. Edwin P. Hubble on "Cepheids in Spiral Nebulae," which was to share in the joint award of the thousand-dollar prize given for an outstanding paper at the Washington meeting. Dr. Hubble, working with the 100-inch Mount Wilson reflector, had succeeded in resolving portions of two of the spiral nebulae, those of Andromeda and Triangulum, into separate stars, and from a study of the period-luminosity curves of the Cepheid variables in the nebulae had derived distances approaching one million light years for each, thus bringing confirmation to the so-called island universe theory.

After the noon recess, the astronomers met for their own papers once more, beginning with a symposium on preparations for the eclipse of January 24. Any reader of the newspapers in the eastern part of the country knows how well the committee on publicity, under the chairmanship of Professor E. W. Brown, advertised and promoted the general observation of this eclipse, not to mention the clear sky which they provided for the inhabitants of New York City and other densely populated districts.

On Thursday evening, the last regular gathering of the Society was an informal dinner. The members had apparently not heard each

other enough during the preceding days, and they called again and again for impromptu discourses until nearly a dozen reluctant individuals had been heard from.

On Friday morning, Washington awoke to find itself in the grip of a snowstorm, and with almost no transportation facilities. A good crowd of members, however, appeared at the new National Research Council Building for the meeting of the American Section of the International Astronomical Union. This body, which acts as a committee of the Research Council, but which is practically appointed by the Astronomical Society, went over numerous technical committee reports, and proposed certain matters for action by the International Union which meets in Cambridge, England, beginning July 14, 1925. It was announced that any American astronomer in good standing will be eligible as a delegate at Cambridge, and a first list includes at least twenty Americans who are planning to attend. President W. W. Campbell, of the American Astronomical Society, is also president of the International Astronomical Union, while the Executive Committee of the Section, which is in charge of the American arrangements, consists of E. W. Brown, *Chairman;* W. W. Campbell, E. B. Frost, Harlow Shapley, and Joel Stebbins, *Secretary.*

New members of the Society were elected at the Washington meeting, bringing the total number up to 416.

T. C. Fry, Western Electric Research Laboratory, 4 West St., New York City.
Charles S. Jewell, 459 Provident Ave., Winnetka, Ill.
Louis V. King, McGill University, Montreal Canada.
David Wonchul Lee, University Observatory, Ann Arbor, Mich.
Dean Potter, Oak Tree Place, Leonia, N. J.
Clifford E. Smith, Sproul Observatory, Swarthmore, Pa.
Norman Wyman Storer, Van Vleck Observatory, Middletown, Conn.
John E. Willis, Naval Observatory, Washington, D. C.
Earl Larkin Williams, Sproul Observatory, Swarthmore, Pa.
E. W. Woolard, U. S. Weather Bureau, Washington, D. C.

The following members were in attendance at the Washington meeting:

S. Albrecht
H. L. Alden
D. Alter
J. A. Anderson
Ida Barney
B. Boss
W. Bowie
L. A. Brigham
E. W. Brown
H. E. Burton
Annie J. Cannon
L. J. Comrie
C. H. Currier
H. D. Curtis
R. H. Curtiss
W. S. Eichelberger
Priscilla Fairfield
E. A. Fath
Jennie V. France
E. B. Frost
Caroline E. Furness
A. Hall
W. M. Hamilton
J. C. Hammond
H. B. Hedrick
J. P. Henderson
L. G. Hoxton
W. J. Humphreys
W. J. Hussey
C. C. Kiess
W. D. Lambert
Eleanor A. Lamson
A. O. Leuschner
F. B. Littell
Hazel M. Losh
W. J. Luyten
D. B. McLaughlin
E. S. Manson, Jr.
R. W. Marriott
C. E. K. Mees
D. H. Menzel
J. A. Miller
J. Millis
S. A. Mitchell
H. L. Morgan
F. R. Moulton
C. P. Olivier
G. F. Paddock
J. Pawling
Cecilia Payne
G. H. Peters
J. H. Pitman
J. M. Poor
E. D. Roe
J. T. Rorer
H. N. Russell
F. H. Safford

H. Shapley	H. T. Stetson	G. Van Biesbroeck
L. Silberstein	R. M. Stewart	A. Vyssotsky
E. C. Slipher	J. Stokley	W. R. Warner
F. Slocum	N. W. Storer	C. B. Watts
P. Sollenberger	J. Tatlock	J. E. Willis
C. M. Sparrow	A. B. Turner	J. E. G. Yalden
J. Stebbins	F. D. Urie	

The next meeting of the Society will be held beginning about September 8, 1925, at Goodsell Observatory, Carleton College, Northfield, Minnesota.

ABSTRACTS OF PAPERS

THE PRESENT STATE OF THE SOLAR RADIATION INVESTIGATIONS OF THE SMITHSONIAN INSTITUTION.

By C. G. Abbot.

The Smithsonian Institution maintains continuously two stations for observing the solar constant of radiation, one in Arizona and one in Chile. The methods of observing are based on Langley's pioneering work published in the Report of the Mt. Whitney Expedition. By an empirical method, based on the fundamental one of observing the sun at high and low altitudes, it has become possible to make as many as five independent determinations at each station on each favorable day, reduce the work, and telegraph the results to the central station at Washington on the same evening. During the past year such daily telegraphic reports have come in regularly. The average difference is less than 0.01 calorie, or one-half per cent. During the past six years, since the daily observations were begun, the well supported range of values has exceeded 8 per cent. Ordinary variations are less than 3 per cent. We are emerging from a low period of solar radiation, extending from the beginning of 1922 to the beginning of 1924, during which the values scarcely ever reached the normal of many years. The present values are approximately normal.

INTERCOMPARISON OF THE SYSTEMS OF TITANIUM AND IRON WAVE-LENGTHS.

By Sebastian Albrecht.

For problems of astronomical spectroscopy, in which it is ordinarily necessary to employ wave-lengths of several elements determined in different laboratories and under a variety of conditions, presumably all based on a single standard system, it is highly desirable that we should have some means of testing the various sets of wave-lengths in order to learn to what extent they really conform to one homogeneous system. With the great instrumental refinements now available, even

such minute differences as .002 or .003 of an Angstrom are important, if of a systematic nature, because several effects which are under investigation depend upon quantities of that order of magnitude.

In the present instance it was desired to compare the recently published titanium wave-lengths of Brown and of Crew with the standards for iron. An indirect method had to be employed. On the basis that in Rowland's Preliminary Table of Solar Spectrum Wave-lengths the systems for iron and titanium coincide, which is a reasonable assumption, Rowland's table can be used as an intermediate system for the intercomparisons contemplated. In this way nearly all of the lines which either set has in common with the intermediate set become available for the intercomparison.

The comparisons indicate that Brown's system of titanium wave-lengths, within the region 4250 to 4820, is on the average .0007 A lower (i. e., smaller wave-lengths) than the system of the Bureau of Standards for iron, with a maximum separation of curves of .004 A. If, however, Brown's wave-lengths, determined with the vacuum-arc, are corrected for the Gale and Adams pressure shifts at one atmosphere, then it appears that the system of Brown is more nearly coincident with the system of the international tertiary standards. Brown's wave-lengths corrected for pressure shifts are on the average .001 A larger than the tertiary standards, and about .003 A larger than the Bureau of Standards wave-lengths. Three possibilities were suggested to account for the observed systematic differences, the most likely one being differences in light source.

In the comparison of Crew's titanium wave-lengths with Rowland, including numerous lines not in Brown's list, there is a tendency toward smaller differences, Rowland minus Crew, for lines faint in the sun than for the bright lines. In the region 3800 to 4900, 38 lines of intensities 4 and greater have solar wave-lengths larger on the average by .008 A than the mean for 384 fainter lines. This may indicate an inward motion on the sun of about half a kilometer per second of the gases in which the lines of intensities 4 and brighter originate, relative to the gases in which the fainter lines originate.

WAVE-LENGTHS IN CLASS-B STELLAR SPECTRA.

By Sebastian Albrecht.

For the determination of wave-lengths in stellar spectra so-called normal wave-lengths, i. e., wave-lengths determined in the laboratory under certain known conditions, are required. In the case of the spectra of a few elements, wave-lengths determined in different laboratories show very discordant results. This happens to be true for the elements of oxygen, nitrogen and silicon, all of which are very important in the early B-type spectra. In fact, the lack of normal wave-lengths for these elements which would be in every respect satisfactory is delaying

the final solution of a number of important problems for these stars.

It is believed that wave-lengths determined from stellar spectra, with the aid of what appear to be the best laboratory wave-lengths at present available, would give certain valuable indications of where additional verification of laboratory results is most needed. The measures of Frost and Adams in Volume II of the *Publications of the Yerkes Observatory* were employed for this purpose. Using as normals the oxygen and nitrogen wave-lengths of Clark, the silicon wave-lengths of Barrell, Merrill's value 4713.381 (blended He), and the Frost and Adams normals for the remaining lines, the stellar wave-lengths were derived which will be published in the near future. A comparison of the newly derived wave-lengths with those previously obtained shows that the systematic differences formerly found between the observed wave-lengths in the early and late B types has been largely eliminated. This is circumstantial evidence to the effect that in a systematic sense the new laboratory wave-lengths are an improvement over the former normal values. Nevertheless a close inspection of the stellar wave-lengths indicates that the recent laboratory wave-lengths could be still further improved.

THE LONG-PERIOD ORBIT OF ALGOL.

By Harold L. Alden.

Parallax plates taken at the Yerkes and McCormick Observatories show displacements of Algol varying with the phase of the long-period orbit. Adopting McLaughlin's provisional elements, (*Astrophysical Journal* **60**, 24, 1924) $P = 1.885$ years, $e = 0.13$ and $T = 1902.793$, the observations were grouped according to phase. The displacements in right ascension and declination can be represented by sine and cosine terms of the eccentric anomaly, where the coefficients are functions of the orbital elements a, i, Ω, and ω.

These coefficients were derived from a least-squares solution together with the parallax and proper motion. The displacements in right ascension and declination, when plotted for corresponding phases, give the apparent orbit. This orbit gives the following preliminary elements:

$$a = 0''.0518 \qquad i = +57°.9 \qquad \Omega = 32°.1 \qquad \omega = 136°.0$$

The eclipsing binary is receding at the node given.

Differential corrections to these quantities have not been derived. It is to be hoped that more accurate spectroscopic data will soon be available. Perturbations within the orbit may be so great that the Yerkes and McCormick data will have to be treated separately. Additional plates are being taken of this star and more reliable results will soon be obtained.

PHOTOGRAPHIC DETERMINATIONS OF MASS RATIOS IN VISUAL BINARY SYSTEMS.

By Harold L. Alden.

The relative masses of components of a visual binary system are determined with the greatest certainty when the proper motion of the center of gravity of the system can be effectively separated from the orbital motion of the components. The suggestion is made that this can frequently be done to best advantage by choosing the direction of measurement at right angles to the middle point of the arc of the relative orbit covered by the observations.

Relative masses have been derived for two systems of particular interest and importance, 40 Eridani and Krueger 60.

40 Eridani is a triple system of large proper motion. The magnitudes of the components are 4.5, 9.4, and 10.8. The two fainter stars form a close double having a period of 180 years. From plates taken with the McCormick refractor at two epochs separated by an interval of seven years, proper motions were derived for all three members of the system relative to four comparison stars. Assuming that the double moves in a circular orbit about the distant bright star, the relative masses in the close binary are as 0.606 to 0.294, the brighter star being the more massive of the two. The double rotates around the bright star with an angular velocity of —0°.0419 per year, corresponding to a period of 8590 years.

In the system of Krueger 60, the proper motion of the center of gravity could be separated from the orbital motion by utilizing measures in declination. Twenty-three plates, extending uniformly over an interval of eight years, give the mass of the fainter star as 0.476 ± 0.0277, the mass of the system being taken as unit. The magnitudes of the components are 9.3 and 10.8.

One pair of plates taken in 1921 contributes nearly two-thirds of the sum of the squares of the weighted residuals. Omitting these, a second solution gives the mass of the fainter component as 0.455 ± 0.0048. This is probably the better value.

Both of the results given above indicate that the fainter star of the system is the less massive of the two. This is in accord with recent ideas of luminosity as a function of the mass.

EQUATIONS MODIFYING SCHUSTER'S PERIODOGRAM.

By Dinsmore Alter.

If a be the amplitude of the best sine curve which we would compute from very short data intervals, and if a' be the amplitude which is computed from long intervals, extending from phase x to phase y,

$$a = a' \, (y - x)/2 \sin \tfrac{1}{2}(y - x).$$

It is thus possible to carry the periodogram to periods as short as

two data intervals, instead of stopping at four or five.

A second equation computes the mean height of the periodogram, instead of measuring it with the planimeter. If ϵ be the probable error of one datum we have,

$$\text{Mean height} = 1.0991\ \epsilon^2.$$

Very often it is not desired to compute a long enough section of the periodogram to give accurately the mean height by measurement. By this equation the mean height may be accurately determined before a single point has been computed.

THE RESULTS OF THE MEETING OF THE SECTION OF GEODESY OF THE INTERNATIONAL GEODETIC AND GEOPHYSICAL UNION OF INTEREST TO ASTRONOMERS.

By William Bowie.

The International Geodetic and Geophysical Union, of which the Section of Geodesy is a branch, met at Madrid, Spain, early in October, 1924, with about 150 delegates representing 25 countries present. It was decided to have the meeting of this Union separate from the meeting of the International Astronomical Union, because it had been found at the meeting of the two Unions in Rome, in 1922, that some of the delegates had to represent their countries at the sessions of both Unions and there were so many overlapping sessions and committee meetings that it seemed desirable, in the future, to have the two Unions meet in different years. The Astronomical Union will meet in England in 1925.

The King of Spain presided at the formal opening of the Union on October 1 and introduced the speakers. This is the first time that the monarch of the country in which an international scientific conference has been held took an active part in the proceedings. Monarchs had been present at formal openings at other conferences but only as a part of the audience. The action of the King of Spain is a tribute to science and to scientific workers which is very highly appreciated.

The Section of Geodesy of the International Geodetic and Geophysical Union, finding so much work to be done, began its deliberations a week before the Union convened.

A decision was made to plan for and engage in the establishment of a world-wide radio longitude net for the purpose of establishing national base stations with high precision and of testing the stability of the continental and island masses of the earth. It is possible now to use radio signals in precision longitude work, and the radio has the advantage over the telegraph lines and cables that stations may be placed at any point on the earth's surface while, before, longitude stations were confined to points along telegraph lines and at ends of cables.

Many scientists of Europe and a few in America believe that continental masses are drifting towards or away from each other. The scientific evidence seems to be against this theory, but by establishing a world longitude net by radio and repeating at intervals of ten or some other number of years, any drifting of one mass with relation to another can be detected.

The spheroid representing the shape and size of the earth, as derived by Professor John F. Hayford, now of Northwestern University, in 1909, while in charge of the geodetic work of the U. S. Coast and Geodetic Survey was adopted at Madrid as the most reliable spheroid in existence.

The Section of Geodesy will assist financially in the computation and adjustment of the observations for variation of latitude, made in the United States, Italy and Japan, during and just after the war, under the old International Geodetic Association, which has been merged into the Section of Geodesy of the International Geodetic and Geophysical Union.

The meeting of the Section of Geodesy at Madrid was, in every way, a great success.

REPORT ON THE HENRY DRAPER EXTENSION.

By Annie J. Cannon.

The publication of the Henry Draper Catalogue, which contains a classification of 225,300 stellar spectra, was completed in June, 1924. Owing to the clear atmosphere at Arequipa, the catalogue contains more than twice as many southern as northern stars. In order to extend the classification to fainter northern stars, the 10-inch Metcalf triplet was mounted at Arequipa, and excellent photographs of the spectra of stars as far north as $+37°$ were obtained. Experiments in 1922 showed that spectra ¼ mm wide could be obtained in which the lines are sufficiently well defined to classify stars as faint as the 11th to 12th magnitude. About 15,000 fainter stars in the Milky Way regions of Aquila, Cygnus, and Taurus have now been classified from these plates. The present discussion, however, deals only with the stars classified on one 8 x 10 plate in the constellation of Cygnus, centered at 20^h, $+37°.5$, galactic longitude 40°, and latitude 1° 30′. The plate covers 45^m in right ascension, and 9° in declination. Within these limits 485 stars appear in the Henry Draper Catalogue, and 3946 additional spectra were classified on this plate, making a total of 4431 stars whose spectra are now known in this portion of the sky containing 81 square degrees. Since about one-third of these stars do not appear in the Bonn Durchmusterung, the positions for 1900 of those in zones $+31°$ to $+40°$ were taken from the Potsdam Astrographic Catalogue.

A laborious part of the work was the determination of the photo-

graphic magnitudes (on the International Scale), which was done by women holding the Edward C. Pickering Fellowship.

A preliminary study of the spectra classified in this region gives the following results:

1. The percentages for the distribution of the various classes of spectra are as follows: B, 6; A, 43; F, 14; G, 12; K, 18; M, 7.
2. The Henry Draper Catalogue contains all the stars within the limits which are brighter than the photographic magnitude 8.0.
3. Between the magnitudes 8.0 and 8.9 seventy-three stars not contained in the Henry Draper Catalogue were classified.
4. To the eleventh magnitude, practically all stars of all types are included.
5. A large number of red stars are found at the eleventh magnitude.
6. Stars to the twelfth magnitude are included and spectra of Class B are found among the faintest stars.

VELOCITIES FROM NARROW CALCIUM ABSORPTION LINES IN THREE NOVAE.

By R. H. Curtiss.

Nineteen plate velocities, derived from duplicate measures of narrow H and K lines on Ann Arbor spectrograms of Nova Geminorum 1912, increase the total of such velocities of this nova to fifty-six, so far as known to the writer. In this connection velocities published from Allegheny number thirteen; from Potsdam, seven; from Ottawa, six; from Mt. Wilson, five; from Bonn, four; and from Pulkowa, two.

Jordan has noted the probability of variations in the velocities from narrow calcium lines measured in the Allegheny spectrograms of this nova; and Stratton with forty-three velocities available, including six preliminary measures from Ann Arbor, has detected movement of these lines toward the violet. The material now available is sufficient to indicate the character of the variation in the velocities derived from narrow H and K absorption in Nova Geminorum over a period of a month beginning at maximum light.

Beginning March 13, 1912, the velocity, derived from the narrow H and K absorption lines and based on all available measures of Nova Geminorum uncorrected for systematic differences, was +7 km, which is within two kilometers of the velocity of the sun in this direction. This velocity decreased uniformly and by April 15, when observations practically ceased, was about zero, or, with allowance for the sun's velocity, —8.7 km.

This progressive negative creep of the H and K velocities can not be accounted for by blending, for the H and K lines separately show the same sort of change. Nor, in all probability, can it be explained as due to increasing hour angle, for the two most extensive series of observations, those made at Allegheny and Ann Arbor, would be af-

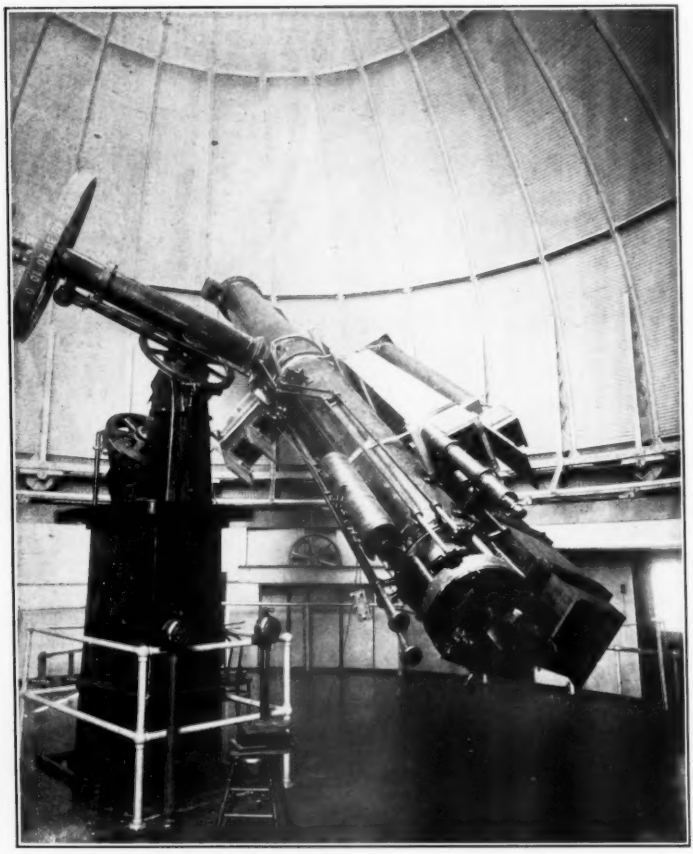
fected oppositely by this source of error. Evidently, also, it is not true that a chance combination of systematic errors in the results of the several contributing observers can account for an important part of the indicated variation. In fact, when systematic corrections applied to the several velocities, based on averages over the interval during which all stations were represented, not only do the results appear more consistent, but the observed negative progression of the H and K velocities referred to the sun is measurably *more* pronounced.

To account for this well defined change from a fixed velocity state to a motion of eight or nine kilometers toward a fixed earth we may appeal to radiation pressure and a possible expansion, both associated with the outburst which accompanied the light change. If radiation pressure was solely responsible we must suppose that the calcium clouds between us and many stars of early spectral class are now, if not originally, too far from the stars concerned to suffer appreciable radiation pressure effects. Further, in Nova Geminorum 1912, the effect of radiation pressure was small before maximum light but produced an appreciable outward acceleration at the brightest phase and continued to do so, possibly with diminished effect, even after the total light had faded considerably. Whether the observed outward acceleration was due to radiation pressure or to expansive outburst or to both, the absorbing calcium cloud was evidently relatively close to this new star.

Forty-six plate velocities derived from narrow H and K lines on spectrograms of Nova Aquilae 1918, extending over a period of nearly three months, and forty-one such velocities of Nova Cygni 1920, over a period of more than a month, do not establish any velocity change, though in the latter there may be some progressive tendency due to hour angle effect. For Nova Aquilae, the average velocity for the K line from Ann Arbor spectrograms was —16.1 km; from the H line, —16.0 km. The velocity of the sun in this direction is +17.2 km. For Nova Cygni the K line and H line velocities were —16.9 km and —16.0 km, respectively, and the sun's velocity toward this nova, +17.2 km. The calcium clouds between these stars and the earth were essentially fixed in space.

(To be continued.)

PLATE IX



THE 20-INCH REFRACTOR OF THE VAN VLECK OBSERVATORY
with 6 cameras attached, January 24, 1925.

THE TOTAL ECLIPSE OF THE SUN, JANUARY 24, 1925.

By FREDERICK SLOCUM.

Most eclipse stories begin with the selection of a site and an account of the journey to some distant land, but my theme is the eclipse that came to me, and so no such introduction is possible.

When the 1925 Almanac came out with the track of the eclipse of January 24, it aroused very little enthusiasm among astronomers. January in New England with the sun only seventeen degrees above the horizon! A waste of time and money was the universal opinion. One veteran eclipse observer announced a year or two ago that he was coming up into Connecticut to sit on a stump and watch—the clouds. A little later he admitted that he might bring one small camera, since the weather records indicated a 50-50 chance. Gradually his program expanded until it included nearly every problem that can be attacked during totality. Such is the lure of the eclipse.

After the fiasco in sunny California in 1923, New England eclipse stock took a rise. I received letters from Santa Catalina and Point Loma, dated September 10, 1923, requesting reservations in, on, or near the Van Vleck Observatory for January 24, 1925. From that time on our prospective party increased until, on the eventful day, more than a score of astronomers assembled here.

On January 15, the eclipse was officially recognized in the following proclamation by Governor Trumbull:

STATE OF CONNECTICUT
By his Excellency
JOHN H. TRUMBULL
Governor

A PROCLAMATION

On Saturday, the twenty-fourth of January, the people of Connecticut are to have an opportunity to witness a scientific event of the first importance—

A TOTAL ECLIPSE OF THE SUN

This phenomenon has been visible in New England only twice since the landing of the Pilgrim Fathers, and only fourteen times in the last two thousand years. On the present occurrence Connecticut has a particularly favorable position in the path of totality and astronomers and others are coming to our state from all parts of the world, to view a natural happening which affords so infrequent occasions for scientific study

I earnestly urge all school authorities and teachers, at some time prior to the coming of the eclipse, to devote a reasonable time for

instruction and explanation of this unusual astronomical event; and to all others for whom it may be convenient I recommend that advantage be taken of this exceptional opportunity to witness a spectacle which is now engaging the attention of scholars and learned institutions of the world. It is a manifestation of the enlightened age in which we live that solar eclipses are no longer regarded, as by the ancients and savages, as auguries of war and disaster, but as opportunities for scientific research, fraught with the possibilities of new fields of knowledge for this generation.

> Given under my hand and seal of the state at the Capitol, in Hartford, this fifteenth day of January, in the year of our Lord, one thousand nine hundred and twenty-five and of the independence of the United States the one hundred and forty-ninth.

(SEAL) (Signed) JOHN H. TRUMBULL.

By His Excellency's Command:

FRANCIS A. PALLOTTI, Secretary.

About a week before the event, newspaper men, photographers and movie men began to arrive. The day before the eclipse all were on hand; the last of the astronomers and their assistants, and the guests who came just to "see," not to "observe."

At 2:00 P. M. on the 23rd, there was a general rehearsal, partly to make sure that everything was working perfectly, partly for the benefit of the guests and newspaper men. The weather was perfect, ten inches of fresh snow on the ground, a cloudless sky and temperature just above zero. Too good to last was the general verdict! But a telegram from Director E. B. Frost from the Yerkes Observatory, reading: "Am sending clear weather. Best wishes for tomorrow," gave us more confidence.

Friday night was clear, and the last focus plates were taken with the temperature below zero. By 2:00 A. M. all the plate holders had been loaded and we were ready. At 6:00 A. M., on the 24th, the trio of planets, Venus, Jupiter, and Mercury rose clear. The sunrise, however, was one to inspire delight in an artist, but consternation in the astronomer. Broken clouds covered the whole heavens. The sun was completely hidden at first contact, at 8:01, but there was a gleam of hope in patches of clear sky that were appearing in the west.

Through the kindness of the American Telegraph and Telephone Co. we had direct telephone and telegraph connections with all the other eclipse stations. The first messages naturally concerned the weather. At 8:00 A. M., Buffalo reported cloudy; Ithaca, partly overcast; Poughkeepsie, clear; New Haven, apparently clearing; Middletown, cloudy.

Half an hour before totality the sun was breaking through and I took several snapshots of the clouds, which will serve in the future to show what a narrow escape we had. Before nine o'clock practically all the clouds had vanished. Just enough haze remained in patches to

show wonderful iridescent colors when illuminated by the narrowing crescent of the sun. In some places the unbroken surface of the snow is said to have assumed the aspect of "acres of diamonds," and a golden sunrise glow surrounded the whole horizon. Five minutes before totality the shadow bands began to appear. They were especially conspicuous on the fresh snow and, according to some, even more conspicuous on the brown stone walls of the observatory.

Although there is an unbroken view of twenty-five miles from the observatory roof, no one saw the moon's shadow on the ground. Three reported seeing the dusky wall approaching, high up in the sky. Totality began about four seconds late, but the duration was exactly as computed, 112.5 seconds.

In the dome with me, in addition to the telephone and telegraph operators, were N. W. Storer, assistant in this observatory; Mr. R. M. Packard of Boston; my niece, Miss Lois T. Slocum, Instructor in Astronomy in Smith College, and Professor H. L. Alden of the Leander McCormick Observatory of the University of Virginia.

Plate IX shows the Van Vleck equatorial with six cameras attached. In addition to the 20-inch lens, 28 feet focus, there are a 4-inch of 25 feet focus, a 3-inch of 12 feet focus (loaned by Brown University), a 6-inch of 7 feet focus, two 5-inch doublets (loaned by Yale), and a short focus 4-inch doublet. Two spectrographs used by the University of Virginia expedition and operated by Professor Alden were located on the declination axis, but were removed before this photograph was taken. Four plates were exposed with the 20-inch and one each with the other instruments. In the meantime Professor B. W. Sitterly observed and photographed the flash spectrum with a small objective prism apparatus. Outside Professors M. B. Crawford and B. H. Camp made careful observations of the shadow bands.

In a shed built against the south wall of the observatory Professor S. A. Mitchell of the Leander McCormick Observatory, assisted by Professor Finch of Columbia University, photographed the flash spectrum and spectrum of the corona with a concave grating spectrograph.

In our transit house Professor Joel Stebbins of the University of Wisconsin and Professor Jakob Kunz of the University of Illinois made observations to determine the intensity of the light of the corona, using a potassium cell. On the roof Professors C. H. Currier and A. deF. Palmer of Brown University and Col. A. C. Matteson of Providence made direct photographs of the corona with cameras of from one to three feet focus.

In an adjoining garage Professor H. T. Stetson of Harvard and Dr. W. W. Coblentz of the Bureau of Standards measured the intensity of the coronal radiations, using a thermocouple. They also made photographs of the shadow bands.

At the physics building near by, Professors Cady, VanDyke, and Powers of Wesleyan made radio tests and took moving pictures of the shadow bands. The Mount Wilson party, Professors J. H. Ander-

son, S. B. Nicholson, and E. Pettit were also located in this building. Their program included photographs of the flash spectrum with a concave grating, coronal radiations with a 20-inch reflector and thermocouple and direct photographs of the corona.

On the roof of Judd Hall, Professor W. G. Foye of Wesleyan and Mr. S. P. Fergusson of the U. S. Weather Bureau made meteorological observations. On the hill just north of the observatory Professor W. I. Milham and a party from Williams College concentrated upon the shadow bands and meteorological observations.

Mr. H. R. Butler, the artist, was at the observatory before and after the eclipse, but made his sketch for a painting of the corona from the roof of the Arragoni Hotel.

Among other guests present were Professor Charles Lassovsky of the Hungarian National Observatory, Budapest; Professor George Lemaitre of the University of Louvain; Major C. V. Woodbury of Norwich Academy; Mr. Garrett P. Serviss, author, and Mr. Leon Barritt, publisher.

As to the results of the observations only preliminary statements can be made at this time and I can speak only for the Van Vleck Observatory.

From the photographs I should consider the corona of an intermediate type (See Plate X). It has all the characteristics of the minimum type, the long equatorial extensions and strong polar rays, but in addition there is an extension of the general corona over the polar regions, enveloping the rays so they appear to be seen through a mist or haze, and there is also a great extension in the northwest quadrant, which is a typical maximum type of formation. On the negatives this is rich in detail, a series of concentric Gothic arches, the base of the outer one being about 300,000 miles wide, and the height of the arch, 375,000 miles. From the top of the arch, on our longest exposures, a thin streamer runs out to a distance somewhat greater than the diameter of the sun. Within the arch, but a trifle out of center is a small, but very bright, pillar-shaped prominence.

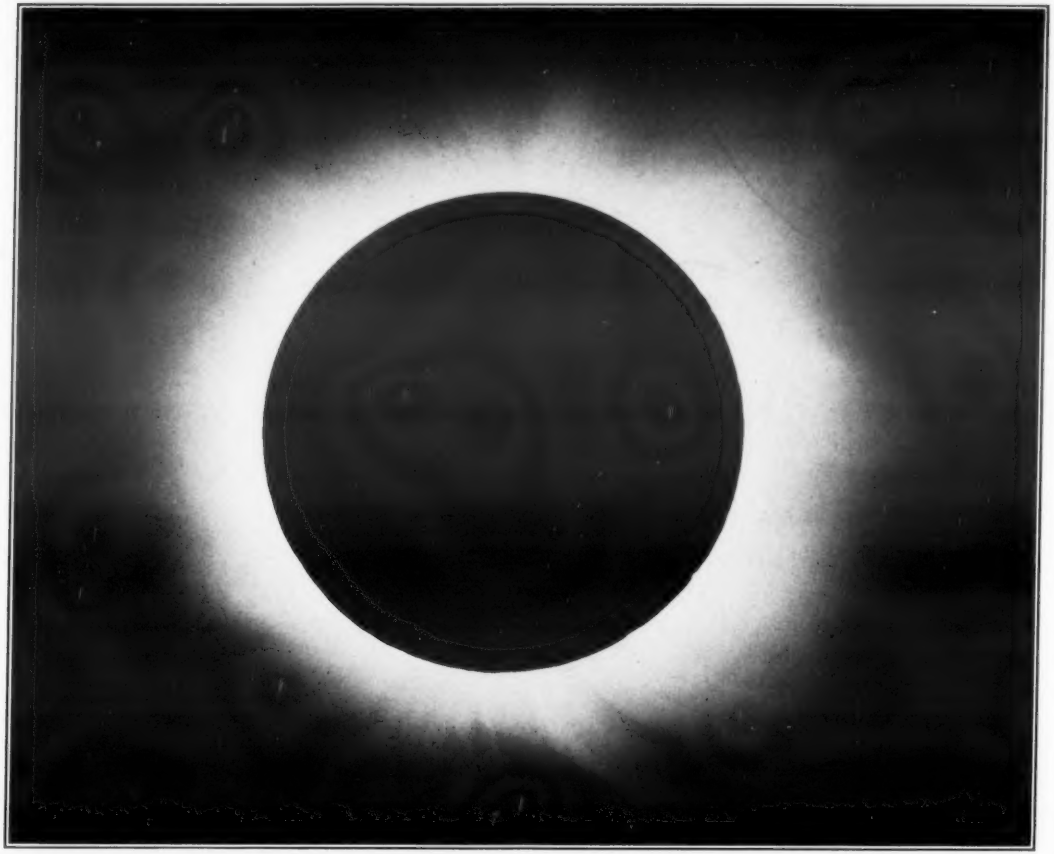
The equatorial streamer in the southwest quadrant extends to an even greater distance than the arch streamer. Between this southwest streamer and the south pole, there is a curious cross current effect. The finest detail is shown on the plates taken with the 4-inch, 25 feet and the 3-inch, 12 feet. The former is a visual lens, but it was treated as photographic and Eastman 40 plates were used. The 3-inch is a photographic lens, ground for the 1900 eclipse. Eastman 40's were used with this also.

The 20-inch and 6-inch are both visual. Minus blue color filters and Cramer Isochromatic plates were used. The general features of the corona in the yellow light are the same as in the blue light, but the minute details have not as yet been carefully compared. On these yellow sensitive plates the prominences are much weaker, as would be

Popular Astronomy, No. 324.

Photograph of the Solar Corona, January 24, 1925, by Frederick Slocum.
[To replace the poorer reproduction given in Popular Astronomy, No. 323.]

PLATE X.



PHOTOGRAPH OF THE SOLAR CORONA, JANUARY 24, 1925, BY FREDERICK SLOCUM.
[To replace the poorer reproduction given in POPULAR ASTRONOMY, No. 323.]

expected, since only the helium light would be effective, whereas on the blue sensitive plates the calcium and blue hydrogen would combine to give strong images.

There were about a dozen small prominences on the sun's limb at the time of totality (See Plate XI). The largest and most interesting one is in the southwest quadrant. It extends to a height of 37,000 miles and runs along the limb 100,000 miles. It shows a very marked resemblance to a prominence photographed on June 20, 1911, and published in POPULAR ASTRONOMY, Vol. XV, p. 412. Both show the long curving filament resembling the trajectory of a skyrocket, fired horizontally from the top of a tower.

All corona plates, except those taken through yellow filters, were backed with "fudge." It would probably have been better if the filtered plates had also been backed. After totality photographs of the partial phase were taken with the 20-inch for determining the relative position of the sun and the moon. On account of the low altitude of the sun and the certainty of bad seeing no attempt was made to attack any of the Einstein problems.

The shadow bands were probably more carefully observed at this, than at any previous eclipse. Professors Crawford and Camp, at my request, concentrated their attention upon the shadow bands and submitted the following excellent reports. Professor Crawford observed a vertical screen, Professor Camp a horizontal surface.

REPORT CONCERNING SHADOW BANDS, SOLAR ECLIPSE OF JANUARY 24, 1925.
By M. B. Crawford.

For the observations described below I used a lantern screen, about 7 ft. high and 8 ft. wide. The screen was hung from two of the windows of the Fayerweather Gymnasium so that the bottom of it was three or four feet from the ground. There was no perceptible wind, so that the screen hung quite smoothly, without motion, against the wall of the building.

I saw nothing that could in any sense be properly called "bands," except, possibly, for a very brief time as noted at the end of this report.

I had expected to start a stop watch when I saw the first signs of bands, and to stop it when the appearance of the bands ceased. Besides the stop watch I had my own watch in view constantly, having fastened the watch to a drawing board on which I had tacked sheets of quadrille ruled paper for notes. When the college clock struck 9, during the eclipse, I noticed that my watch was ten seconds slow, as compared with the first stroke of the clock.

The first disturbance which I noticed on the screen was a faint, irregular fluttering motion such as I have sometimes seen when light, passing across a heated surface or the top of a kettle in which water is boiling, strikes on a wall beyond. Almost immediately a drift of this

fluttering motion showed itself from the right hand upper portion of the screen downward toward the left, making an angle of about 60° with the vertical.

(In noting the direction of motion on the screen, I did not record degrees as here indicated, and as used later in this report. I simply indicated the direction in each case by an arrow drawn on the paper with quadrille ruling which I was using, and these specifications of degrees here given only roughly correspond to the angles shown between the arrows which I actually drew at the time and the vertical lines on the paper.)

Thinking that this motion which I had observed could not be the "bands" which I was to observe, I did not start the stop watch, supposing that the "bands" would appear later. I noticed, however, that this fluttering began about 9:07 as shown by my watch.

At 9:09 it was more marked, but the direction of motion was directly from the right to the left.

At 9:10 the appearance was the same, except that it was more violent.

At 9:11 the motion, and also the turbulence or boiling effect, were very marked, the direction of motion, however, being now nearly vertically downward, slightly inclined to the left.

At $9^h\ 11^m\ 15^s$ I made my last note of time (before totality), no bands being yet visible. The whole screen gave a combined appearance of boiling and drifting, not different from what I had noticed earlier, but even more marked by turbulence than at 9:11. From then till the beginning of totality the appearance was the same, the direction of drift being substantially that indicated above for 9:11.

The disturbance at its maximum intensity reminded me more than anything else of a driving fall of snow of *very* large flakes,—except that the darker patches on the screen were larger than any flakes of snow I ever saw, and the light spaces between them as they swept obliquely downward were more marked than they would be in the case of an actual fall of snow,—conceivably as they might appear, if one could look through a vertical section of a snow squall only a few feet thick.

Assuming my first time observation to have been correct, at 9:07 (it might easily have been in error by a quarter of a minute, because the unexpected appearance took me by surprise), and assuming that the disturbances apparent on the screen ceased at the beginning of totality (I did not time the cessation of the disturbance), and assuming also the instant of second contact at 9:12:30, the total duration of the apparent motion on the screen before the second contact was 5½ minutes.

I timed the duration of the disturbance seen after totality with a stop watch. The duration of the whole phenomenon from the instant I first noticed it till I was sure it had completely died away, was 3 minutes, 21 seconds.

The appearance was just the same in character as that described

above for the time before totality, except, of course, that the order of the changes was reversed, i. e., the motion was turbulent and swift at the beginning, dying away in intensity, and also, I *think*, in rapidity, toward the end, although on this latter point I made no note at the time.

The direction of apparent motion after totality was even more variable than before totality. At first it was like thick snow driving from above at the right, down toward the left, at an angle of about 45°.

Soon it changed to a motion from above at the left, down toward the right, again at 45°.

At about 9:15:30 by my watch it changed back to about its first direction from above right, downward towards the left.

Just before it vanished, I thought the motion was obliquely upward and to the left making an angle of about 60° with the vertical.

Very near the end of the disturbance on the screen I saw for a very short time what might possibly be called bands, namely three approximately vertical patches shaped somewhat like three great fingers, as I remember them, although I had not time to sketch them. They were on the lower part of the screen, and might have been three to four feet in height, and somewhat less in total breadth across the widest part of the whole group. They were slightly fan-shaped in appearance, rather than being strictly parallel bands. I do not consider this observation very trustworthy.

Except for unimportant changes in phraseology, the above report is as I wrote it out on the morning of January 24 almost immediately after the eclipse.

(Signed) Morris B. Crawford.

Middletown, Conn., Jan. 27, 1925.

Report on Observations of Shadow Bands, Eclipse, January 24, 1925, Wesleyan University, Middletown, Conn.

Observer: B. H. Camp.

Place: Snow covered back campus.

Method of Observation: (Some difficulty was experienced, especially at first, because the phenomena were not as expected. It was anticipated that they would be well defined bands, like the stripes of a flag, perhaps ringed, but measurable. They were found to be instead flickering and elusive.) The shadows were observed during two periods, one just preceding totality, and one just after it.

Before Totality: The time, as given by a watch lying on a board, was noted on a sheet of paper every 15 seconds after 9 hours 4 minutes. This watch was afterwards found by Mr. Storer to be 11 seconds fast by comparison with the chronometer. (All figures given here are given in watch time. To get standard time subtract 11 seconds.) Thus the beginning of the period was obtained approximately as $9^h\ 08^m\ 07^s$, for the last time recorded was $9^h\ 08^m\ 00^s$. The duration of the first period was then obtained by a stop watch carried in the hand.

As soon as the observer was sure he saw the shadows, he snapped the stop watch. Roughly 15 seconds thereafter, he began to walk toward the sun making marks in the snow indicating the direction of motion of the rapidly moving shadows, sometimes pausing to print a letter or two indicating other characteristics of them. A stake was stuck in the snow indicating the place of the observer when the shadows ceased. Totality was then observed to have just begun.

Immediately after the eclipse was over, these marks were copied, and their bearings noted by a compass, and at the same time some general descriptive remarks were written down. The distance walked was measured, and recorded every five meters. There is thus presented a consecutive series of pictures of the motion. These pictures are also approximately (though the approximation is very rough) equispaced in time, and accordingly an estimate of the time of each picture is given below.

After Totality: The same methods were followed, with two exceptions. First, with better experience, the observer was able to make twice as many observations in the same time. Second, the observer had but one stop watch, and this should not be read until afterwards, and was not therefore again available. Accordingly, when the shadows ceased, he ran back to his starting place, and noted the time on the watch originally used, and still lying on the board. He had noted that the shadows commenced less than one second after totality ceased. This moment was known at the observatory. The interval could then be calculated, the time necessary for the run back being found afterwards by experiment. (The times for the beginning and ending of totality given in the paper are the predicted times, and not the observed times. Further slight correction may therefore be necessary.)

The intervals found were, first period, $4^m 21^s.6$; second period, $2^m 31^s$. The *first* shadow in the first period was probably not noted. The shadows did not burst into view all at once. In fact, they did not fade out all at once at the end of the second period, for after the observer had supposed them gone, and had started back to look at his watch, he stopped, after a ten seconds' run, and noted one more flickering shadow.

General Nature of Shadows: (This is a fuller expression of the views written down at the time.) These shadows continually flickered, like a bad movie. They were in no sense measurable bands. A rough guess at the distance across the bands from crest to crest was written once in the snow as one foot. Only occasionally and momentarily was anything like a succession of parallel bands seen. Then they flickered like the spokes of a rapidly rotating wheel. In fact, the observer could not be sure whether they were parallel or radiating. They had no sharp lines marking the brighter from the darker portions, not even as sharp lines as poor interference fringes, and the several bands did not retain their individualities; they quickly enveloped each other. The motion, too, was not well defined. It was swirling, eddying, at times

PLATE XI

N

E

W

PHOTOGRAPH OF THE INNER CORONA AND PROMINENCES
during the Total Solar Eclipse, January 24, 1925, by Frederick Slocum.

drifting swiftly in a fixed direction, and quickly changing to a rotation, and again a drift. Sometimes the shadows seemed to stand still and only flicker, but it was not possible to be even certain that they were truly still. They may have been moving so fast and at the same time flickering so fast that the drifting motion was not discernible. The velocity of motion was variable and closely resembled the speed of drifting snow, sometimes as in a high wind, sometimes as in a lull. Indeed, save for the occasional and elusive band-like appearances already noted, the shadows looked like drifting snow. Sometimes the flecks were too large to be snow flakes but much of the time they were quite as small. The most impressive part of the pictures was the flickering uncertainty of it, and the next most impressive part was the swirling, drifting motion. Now, although this gave the impression of being very variable, both in speed and direction, it is to be noted that the observations do show that its direction was *almost* always between 10 and 45 degrees to the east of magnetic south, i. e., from 22 to 57 degrees to the east of true south, and it was *always* between true S 112 E, and S 68 W. The average of all the estimates given below is true S 36.5 E. The direction of motion in the second stage was more nearly uniform than in the first. The average direction of the first period is true S 2.6 E, and of the second true S 53.5 E. As well as can be remembered, it is correct to say that the drifting motion was

RÉSUMÉ OF RECORDS.

First Period.

Watch Time	Elapsed Time	Direction of Motion*	Remarks
$9^h\ 08^m\ 22^s$	0^s		Shadows first seen
	15^s to 80^s	—60°	Rotation
		25	
		10	
		—80	Rotation
		—30	
		—80	Rotation
		15	(Motion is always straight
		30	unless otherwise stated)
	80^s to 145^s	20	Faster
		—70	
		—60	
		25	Very fast
		10	
	145^s to 210^s		One foot between bands
		30	Mixed, then drifting
		20	
	210^s to 261^s6	20	
		15	Twinkling and end, totality begun

$9^h\ 12^m\ 28^s6 = 261.6$

As the predicted watch time of totality was $9^h\ 12^m\ 45^s$, this indicates an error in the estimate of the beginning of the period of at least 16 seconds. This was doubtless due to hesitancy at the start. Another quarter of a minute should have been recorded while the observer was hesitating, not knowing whether he saw the shadows or not.

*Plus is E. of Magnetic S. Minus is W. of Magnetic S.

Second Period.

Watch Time	Elapsed Time	Direction of Motion*	Remarks
$9^h\ 14^m\ 42^s$	0^s		Totality just ended
	0^s to 18^s	45	Twinkling
		75	Rotation
		20	
		10	
	18^s to 36^s	20	
		10	
		15	
		10	
		10	
	36^s to 54^s	20	
		30	
		85	Rotation
		45	
	54^s to 72^s	60	
		50	
		25	
		80	
	72^s to 90^s	75	
		60	
		40	
		50	
	90^s to 108^s	40	
		30	
		40	
		40	
		45	
	108^s to 126^s	40	
		30	
		30	
		30	
	126^s to 141^s	30	
		30	
		90	Rotation
$9^h\ 17^m\ 13^s$	151^s	100	Nothing for 10^s and then this last flicker was noticed

on the whole more rapid than the eddying to either side. The fact that the drift was in general southeasterly may, of course, be due to local conditions rather than to the fact that the sun was in that direction. The wind was probably westerly in direction, but was too feeble to be noted on the campus.

From the many other reports sent to me I quote the following sentences:

From within a room, "A glance at the window panes would lead one to believe it was raining. The shimmerings on the panes where the shadow bands did their fantastic little dance looked for all the world as if drops of rain were striking against the glass."

"The shadow bands looked like the very irregular ripples in water running down a rough sidewalk."

Four minutes before totality, "They seemed to be moving in two directions, the stronger towards the northeast, the weaker due south."

"They were so numerous and ran in so many directions I could not decide upon any particular trend."

"They looked like a swarm of lizards wriggling over the snow."
"When the bands came up to a tree they ran around it."
"They changed their direction of drift several times, abruptly."

As a spectacle the eclipse was all that could be desired. The newspapers had been "playing up" the eclipse for over a month and the public was keyed up for a grand display. There were, of course, some skeptics. Here are some remarks overheard on a train. "These astronomer men don't know anything about it." "I don't believe anything is going to happen, but, just out of curiosity, I am going down into Connecticut to see." "The thing may take place, but it's liable to be a day or two behind time." Had it been cloudy a large portion of the public would have lost all faith in the astronomers and "newspaper fakirs," but, as it was, I have yet to hear of anyone that was disappointed.

The setting was ideal; a low sun, easy to watch; enough clouds to add color to the picture and also an element of uncertainty as to the outcome. Observatory Hill was thronged with people as was Indian Hill to the west. As the sky rapidly darkened, a few minutes before totality, all conversation ceased. The silence was most impressive. A thousand people within a hundred yards and absolutely not a sound. As the corona appeared there was a low murmur of surprise, but when the sun burst forth again, there was wild applause, handclapping, and cheering.

In the dome a few minutes before totality, the slides of the nine instruments were drawn and I began to watch the diminishing crescent with the 3-inch finder. As the tips of the crescent began to break into beads, a warning "Stand by!" was given. The metronome was started. The telephone and telegraph operators closed their circuits and stood where they could watch the show. The circlet of beads gradually shortened at the ends and extended in towards the center, the last three beads vanishing simultaneously. At that instant "Go!" was called and the chronograph key pressed to record the time of second contact.

Mr. Packard began to count the seconds and the program of exposures was started. Twelve exposures were made with the various instruments during totality. Professor Alden worked the two Virginia spectrographs and the Yale twin 5-s; Mr. Storer the 12 ft. and 7 ft.; Miss Slocum the 4-inch doublet, and I the 20-inch and the long focus 4-inch. After totality, with the 20-inch, I took a series of 25 exposures on the partial phase.

In the mean time, the reporters and guests, who had stepped outside during totality, swarmed into the observatory to thaw out and receive reports from the various groups of observers.

As I came down from the dome with a market basket filled with plate holders, one reporter remarked that I looked happy with my

basket of golden eggs, and I suppose that was true, in spite of the fact that the tips of my fingers were frozen.

Reports came in turn from the other parties in and around the observatory and campus, in each case "Program apparently successful." An hour or two after the eclipse, Stebbins and Kunz were still making calibration readings on their galvanometers. During totality both were seated at microscopes behind a pier, making readings every ten seconds. In order that they might get a view of the corona, a mirror was placed on the wall at the proper angle. When, at last, they had finished their work, and the door of the transit room opened, the first remarks heard were, "Joel, did you get a good view of the corona?" "No, Jakob, what did it look like?" "I don't know, I didn't see it, either."

Joel and Jakob, the conscientious J's! I suspect that neither really intended to look in the mirror when it was put up. Each thought it was for the benefit of the other and now the Van Vleck Observatory is the richer by one good mirror.

Gradually the crowd faded away. By Sunday only a few of the astronomers were left. They were busy, developing plates, dismantling and repacking instruments, to be used again—when and where? In Sumatra in 1926 or 1929? In England June 29, 1927? Among the South Sea Islands in 1930? Or in Maine in 1932? Portland, Maine, 3:30 P. M., August 31, 1932! That ought to promise something better than the Connecticut "50-50." Let us hope the fulfillment will be as good.

Van Vleck Observatory, Middletown, Conn.

THE ECLIPSE OBSERVATIONS AT THE YALE OBSERVATORY.

By E. W. BROWN.

The photographs taken at the Yale Observatory on the morning of the eclipse have now been developed and constitute a fairly complete record of the phenomena to be seen.

The program of observation was laid down by Director Schlesinger in consultation with the staff of the Observatory before his departure for South Africa. The responsibility for carrying out the various changes needed in the instruments and getting them in working order was placed on Mr. C. L. Stearns, and such success as was obtained was largely due to the careful preparations which he made. Some considerable alterations were necessary. The guides for the sliding roof of the Loomis Telescope had to be extended in order that the image of the sun should be able to reach the mirror. For the Catalogue Camera a special plate-holder had to be constructed and a hole cut in the wall of the building to enable the camera to be pointed at the sun. The Waldo

Doublet was placed on the axis of the Reed Telescope and accurately adjusted so as to point in the right direction. The pendulum camera required complete construction, the only material available being one of the lenses formerly used to photograph meteors, with its box.

The Loomis Telescope, which Mr. Stearns himself operated, was used to take photographs during the partial phases as well as during totality, it being intended to use these for measurement of the position of the moon at those times and for measurement of its diameter. The low altitude of the sun caused considerable difficulties in securing a proper focus. The image, which is five inches in diameter, shows several prominences, one a beautiful arch some 50,000 miles in height. In all, six plates were taken during the partial phases and six plates during totality. Excellent photographs were taken with the Catalogue Camra, which was operated by Messrs. Donald Cooksey and J. E. Henderson of the Physics Department of the University. These photographs show an image of the sun about an inch in diameter with the structure of the corona beautifully marked. In the photographs taken with the Waldo Doublet, the outer structure is visible for some considerable extent. This camera was operated by Messrs. T. H. Johnson, B. T. Barnes, and C. Del Rosario of the Physics Department. All the photographs which were planned by Mr. Stearns to be taken were successfully secured.

The pendulum camera was an experiment designed to try if images of the sun could be secured automatically at intervals of a second or so throughout the whole of totality. The apparatus was quite roughly constructed but served to show that this form of camera can be used on future occasions. The exposures are given by an opening in a plate which oscillates on a pendulum in front of the lens of the camera at one-second intervals. A film twenty-five feet long on a spool was used, the film being moved automatically by rachet, gears and cords on drums, about two inches between each exposure. Some twenty or more good pictures of the corona were secured. The most important result, however, was the proof that the corona could be photographed at least seventeen seconds before totality, traces of it being found on the pictures taken at that time. The inner structure of the corona is well shown on some of the photographs. This camera was operated by Professor Brown with the assistance of Mr. H. O. Stearns of the Physics Department.

Measurements of the temperature were taken by Miss Barney with the assistance of Mrs. Cabot and Miss Gesler of the Observatory staff. These were started at first contact and carried right through the whole eclipse. Two accurate thermometers, placed respectively in the Zenith Camera house and the Loomis tower showed no change of temperature that could be ascribed to the covering of the sun by the moon. The thermometer in the Catalogue room showed a drop of two degrees, but this thermometer was only of ordinary commercial make and it is doubtful if much reliance can be placed on its indications.

The Yale Observatory was the headquarters for the through telegraphic and telephonic communication set up by the American Telephone and Telegraph Company for the assistance of astronomers at the time of the eclipse. This through communication involved receiving and sending signals to observers stationed at Buffalo, Ithaca, Poughkeepsie, Middletown, New York, and East Hampton. The communication was established well before the eclipse and information distributed as to weather at the various points. It was cloudy at Buffalo, but more eastern stations received successively signals from Ithaca, Poughkeepsie, and New Haven concerning the time of scond contact, so that these stations knew in advance the difference between the predicted and observed times. On receipt these were megaphoned to the observers stationed on the Observatory grounds and were of great assistance in helping to secure photographs of the flash spectrum, which is only seen at the instants just before and after totality. At the request of the Acting Director Mr. H. Clyde Snook, head of the Laboratories of the Western Electric Company, took charge of the time signals at New Haven, and both reception and sending of signals went through without error. It is hoped that this novel experiment may be repeated on a similar future occasion. The eclipse was about 4 seconds late.

THE ECLIPSE EXPEDITION AT WINDSOR, CONNECTICUT JANUARY 24, 1925.

By ALICE H. FARNSWORTH.

In the past the phrase "eclipse expedition" has conveyed to most of us a picture of a group of temporary wooden buildings, numerous instruments of varied size and character round about, anywhere from one to fifty (witness Catalina) toiling astronomers with their assistants, a few inconspicuous natives on the outskirts—all set down in the midst of a hot, dusty wilderness. In this tradition-breaking age it is not to be wondered at if the morning of January 24, 1925, looked upon scenes of a different character. Certainly the eclipse pilgrimage of Smith and Mount Holyoke Colleges to the golf-links of the Plymouth Meadow Country Club of Windsor, Connecticut, presented as strong a contrast to tradition as can well be imagined. No buildings, only college banners of yellow and blue, with smaller pennants in all the rainbow colors to mark the gathering places for various groups of observers; instruments inconspicuous and few and far between, only such as could be carried in the hands; instead of toiling astronomers, care-free girls to the number of 1700, with a sprinkling of college faculty, Windsor inhabitants, reporters, and camera men; in place of dust, a crusty snow; and an "absence of heat" which sent the thermometer well below zero at the close of totality. The accompanying pictures, taken 10 and 20

minutes after totality to indicate the reverse of "gathering gloom," show the wintry landscape, while the human sky-line in another snapshot gives a somewhat adequate idea of the density of population on the observing ground, outside the lines stretched for the protection of less carefree observers.

The avowed chief aims of the leaders of the expedition were the arousing of the college public to an enthusiastic and intelligent interest in the eclipse before the event, and the provision of means of transportation for all members of the colleges who wished to travel into the shadow-track on January 24. Scientific aims were entirely subordinate. The fact that a dozen trolleys were necessary to carry the Mount Holyoke students to their special train in Holyoke, and that two other trainloads of Smith girls made the trip from Northampton to Windsor, bears witness, in a gratifying degree, to the realization of the expressed aims.

Students in astronomy were trained beforehand for such observations as could be made with little or no optical aid. These included a study of shadow-bands, watching for the moon's shadow to come and go, timing contacts, identification of stars and planets, sketching the corona, search for chromosphere and prominences, reading temperature, testing illumination, small-scale photography, looking for coronal shadows, noting coloring of sky and landscape as well as of the eclipsed sun.

New England weather, as always, capriciously disposed, did not leave us without anxiety on the morning of the eclipse. Beautifully clear at 5:30 A. M., before 6:00 the sky was entirely covered with clouds which did not allow the sun even to peep through until a few minutes after first contact, when we were able to see from the train that the eclipse had begun. From that time on the vicinity of the sun was never free from clouds; at frequent intervals uncomfortably close to the time of totality, the sun was obscured by very local clouds in the shape of pillars of smoke from the "special" engines which went puffing back and forth, apparently entirely oblivious to their unparallelled opportunity to stand still and behold. Totality occurred, however, with a gloriously clear sun; the clouds round about displayed exquisite color effects and completely covered the sun thirteen minutes after totality.

Printed folders containing directions for observing served also as record sheets and it is from those that were turned in after the eclipse that the following results were gathered. Only a few report seeing the shadow advancing from the west. Shadow-bands were very generally observed. They appeared for a period of one or one-and-a-half minutes immediately preceding and following totality. Estimates of their width varied from ¼ inch to 3 inches; of their distance apart from ¼ inch to 4 and 6 inches, so that they were apparently not uniform as seen from different parts of the observing ground. Their shimmering, elusive quality made it very difficult to estimate velocity; several judged that about 5 passed a given point in a second. The direction in which

they travelled before totality was in general from west to east; more observers report southwest to northeast than northwest to southeast. Most observers noted a change in direction after totality, but estimates of the amount of change vary from 15° to a complete reversal or change of 180°. There was practically no wind at the time.

Totality began about six seconds later than predicted; estimates of its duration average 82 seconds (range 81 to 83). The readings of two thermometers were not wholly consistent. One indicated a drop from +1°.4 F. at 9:00 to —3°.9 at 9:17; the other read +1°.4 at 8:50 and —5°.8 at 9:15 and 9:18. Much surprise was expressed at the amount of light during totality, probably due in part to the snow which covered the ground. Fine print (4½ point) which had been read only with difficulty during full moonlight was read easily during totality. No one had any trouble in reading the second-hand of her watch and some were able to read the numbers of their films in small cameras. Readings of a foot-candle meter, measuring the illumination on a horizontal surface, changed from 40, two minutes before totality, to 0.14 during totality, indicating an intensity-ratio of 300 to 1.

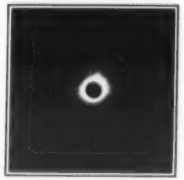
The flash spectrum and bright chromospheric arcs were seen with combinations of opera-glass and replica grating and the bright sodium line with a small direct-vision spectroscope. More than half of those reporting had a glimpse of the chromosphere (possibly a prominence) on the northwestern rim of the sun. Prominences were not *certainly* seen except by an observer with a 2½-inch telescope.

The corona was intermediate in type, the long rays or streamers in high latitudes giving it a distinctly "spoked" appearance; the longest of these streamers could be traced from one to two solar diameters beyond the dark disk of the moon. The streamers on the western side were longer and more numerous than those on the eastern. The corona was distinctly visible for a few seconds before the sun disappeared and many noted that it remained visible for several seconds after totality. This would indicate that the inner corona would have been visible to observers just beyond the shadow track.

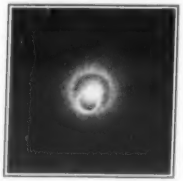
Probably no one failed to see the group of three planets west of the sun. Venus was first seen 8 or 10 minutes before totality and was still visible 13 minutes after when clouds covered it. Jupiter was noted 2 or 3 minutes before and for 6 minutes after totality, and Mercury for only a minute or two before and after. Several observers saw Saturn in the southwest. Among the stars, Vega, Altair, and Deneb were identified and two observers report seeing 6 stars besides the group of three planets.

The would-be photographers worked at a tremendous disadvantage on account of the low temperature and many exposures were unsuccessful because of clumsy gloved fingers and frozen exposure shutters. The largest scale photographs gave images of the moon's disk 2 and 3 mm in diameter. One of these, an exposure of ten seconds, is reproduced here. The original negative shows streamers extending to one

PLATE XII



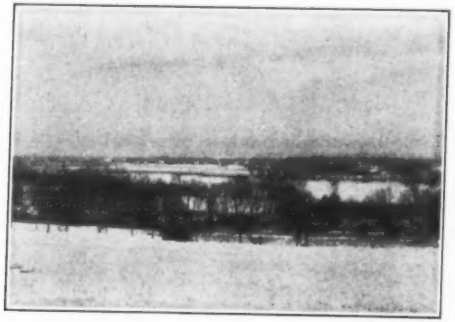
Corona photographed with camera of 14-inch focal length, exposure 10ˢ.



End of totality showing "Diamond Ring" effect.

A Part of the Group of Observers at Windsor, Connecticut.

Ten Minutes after Totality.



Twenty Minutes after Totality.
Same Landscape; Negatives developed and printed together.

and a half solar diameters. Another exposure, destined to be a still longer exposure for the outer corona, was cut short by the re-appearing sun and shows well the "diamond ring" effect which was so universally noted. Those who worked with small kodaks counted themselves fortunate to obtain a tiny ring of inner corona as it appeared over the landscape. A few succeeded in obtaining satisfactory images of the crescent sun during the partial phase.

John Payson Williston Observatory,
Mount Holyoke College, South Hadley, Mass., Feb. 14, 1925.

THE TOTAL SOLAR ECLIPSE OF JANUARY TWENTY-FOURTH AT MT. BEACON, NEW YORK.

By MRS. ISABEL M. LEWIS.

The advantages of observing the eclipse from Mt. Beacon, N. Y., which has an elevation of 1400 feet and affords a superb view of the Hudson River Valley, had been pointed out to us some days before the eclipse by Rev. H. O. Du Bois of New York City, who later joined us in observing the eclipse from this point with his daughter, Mary Constance Du Bois, and his sister, Mrs. John B. Burnham.

Mt. Beacon is about one mile south of the town of Beacon, formerly called Fishkill Landing, on the Hudson River opposite Newburgh, and it was about five miles south of the central line of total eclipse.

Our little party of six observers, Rev. H. O. Du Bois, his sister and daughter, my husband, Clifford S. Lewis, Assistant Nautical Almanac Office, U. S. Naval Observatory, our ten year old son, Raymond, and myself reached the summit of Mt. Beacon by the funicular railway up the precipitous slope slightly before eight A. M. There was a hotel on the mountain top close to the terminal of the railway and it was open that morning for the convenience of the several score of observers who had made the ascent of the mountain to observe the eclipse. A most welcome fire was burning in the fireplace in the dining hall. The point from which we observed the eclipse was about one hundred feet from the hotel, a large flat rocky prominence surrounded by an extensive stretch of snow unbroken by trees or other obstructions, forming an ideal background for the observation of the shadow bands. About twenty people were gathered at this point and here I had the pleasure of meeting Dr. M. B. Snyder, director of the Philadelphia Observatory, who has indicated on my sketch of the corona two prominences of the southwestern limb of the sun that I failed to see. At this same point on her sketch Miss Du Bois has indicated what she believes to have been the appearance of Baily's Beads at the conclusion of totality.

At seven A. M. our hopes of seeing the eclipse were very low, for the entire eastern half of the sky was covered with mottled clouds reaching

nearly to the zenith. These cleared away with astonishing rapidity, however, and shortly after first contact at 8:01 A. M. the sun was shining brilliantly in a sky of crystal clearness and the eclipse took place under ideal conditions. The air was absolutely motionless and the cold was intense. Across the river at Newburgh, we were told later, they were calling out temperature readings at short intervals. The temperature was four degrees below zero there with a drop of two degrees during totality. Mr. Lewis was the only member of our party to feel a drop in the temperature during totality. Personally I was so cold that I do not think a drop of two degrees would have registered any impression.

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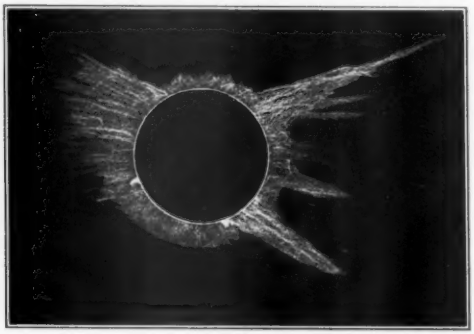

SKETCH OF THE SOLAR CORONA BY
MRS. ISABEL M. LEWIS

Our plans of observation had been talked over at the hotel in Beacon when we all met there on the afternoon before. Mrs. John B. Burnham, who is an artist, Miss Du Bois and I were to make sketches of the corona. For this purpose I pasted sheets of drawing paper on the stiff pasteboard backs of drawing pads and drew on each circles of equal radius to represent the lunar disk, that the three drawings might be on the same scale and to save time during totality. These drawings we made during totality though our fingers were too stiff with cold to permit us to draw well. A comparison of the sketches after totality showed we had all caught the two conspicuous streamers to the west of the sun. The corona to the east of the sun appeared very different from what it was to the west. There were no extensive streamers but a more uniform, brushy development. I observed without binoculars and saw no prominences, but the streamer to the northwest was easily traced to a distance of one and a half solar diameters. I was particularly impressed by the fact that the corona appeared fully twenty seconds before totality and was visible for an equal time after totality. When it first appeared I was looking westward for the shadow, but an

awestruck "Oh!" from someone brought me around to face the corona with a speck of sunlight still shining on the eastern limb. I could not again turn my back on that spectacle, so missed the coming of the shadow which we had all expected to see at that elevation but which I believe no one saw, though one observer spoke of seeing the shadow speed away after totality. The corona was described by Mr. Du Bois

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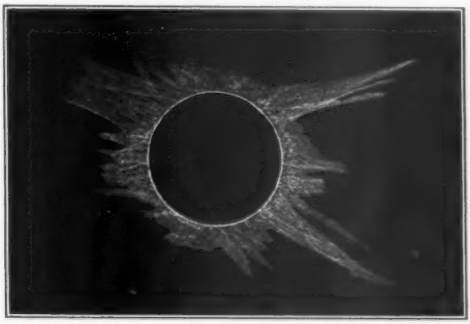


SKETCH OF THE SOLAR CORONA BY
MRS. JOHN B. BURNHAM

as pure white, by Mr. Lewis as creamy white. To me the inner corona was tinged with yellow and the outer coronal streamers were white. Before totality, at the first appearance of the corona, I was struck with the appearance of the rosy light of the chromosphere tinged slightly with green along an arc of about sixty degrees, including the base of the longest streamer. I was impressed with the beautiful color effect at this portion of the circumference, which disappeared during totality, and also with the fact that it should appear here where I least expected to see it.

For observing the times of contact and duration we were provided with binoculars and two stop watches. One of these watches and a pair of binoculars had been loaned to Mr. Lewis and myself by the U. S. Naval Observatory. The other watch was loaned to me in New York City the afternoon of the twenty-third and I returned it the afternoon of the eclipse. Both watches were compared by radio with the Arlington time signals in Beacon at 10 P. M. the night before, and the Observatory watch was compared again in New York at 10 P. M. on the day of the eclipse. It showed a gain of four seconds in twenty-four hours. It was impossible to get the special eclipse signals on Mt. Beacon.

Mr. Lewis watched for the contacts with binoculars and signalled to Mr. Du Bois and myself who held the watches. According to the Ob-

servatory watch which Mr. Du Bois held, the total eclipse began at $9^h\ 10^m\ 42^s.4$, or 1.8 seconds later than the calculated time of beginning. Mr. Lewis had calculated the times of beginning and ending of the eclipse for Mt. Beacon before we left Washington, using the positions given by the Coast and Geodetic Survey for Bald Mt. which was found to be the same as Mt. Beacon. I had checked the computation and we found that the total eclipse should begin at $9^h\ 10^m\ 40^s.56$ and end at $9^h\ 12^m\ 39^s.30$, giving a duration of $1^m\ 58^s.74$.

Our observed time seemed to be about two seconds less than the average obtained at other points, which showed the eclipse to be four seconds late.

The watch which I used, though unreliable in rate and giving a beginning fourteen seconds early, had two stop hands and therefore gave a value of duration which should not be affected appreciably in less than two minutes by the uncertain rate. The duration shown by this watch was $1^m\ 55^s.8$, which is 2.9 seconds less than the calculated duration. This difference seems rather larger than one should expect.

So far I have not referred to the shadow bands but they were to me one of the most impressive features of the eclipse.

They appeared fully three minutes before totality, distinctly visible against the background of snow surrounding us on all sides. My attention was called to them by the young man next to me, calling out, "There are your shadow bands!" At the same time there was a cry of dismay from Raymond, who had taken over the observation of the shadow bands as his particular contribution to the eclipse observations, and who knew what to look for and how to make his observations. He had been given two rulers, one to lay down parallel to the wave-fronts of the shadow bands before totality and the other after totality. As he attempted to lay down his first ruler the slight slope of the crusted snow caused it to slide off a distance of ten feet or so, which brought forth the cry of dismay. After recovering the ruler he succeeded in placing it parallel to the wave fronts and also placed the second ruler parallel to the wave fronts of the shadow bands that appeared after totality. The direction of the two rulers did not differ more than five degrees in position and agreed closely with the estimate of direction of other observers. As we stood facing the sun the direction of motion of shadow bands was from the right toward the left both before and after totality, or from southwest to northeast. To me the direction from which the shadow bands were coming seemed to shift slightly more to the westward after totality. To me this definiteness of direction was one of the most remarkable features of the shadow bands. When first seen they were mere threads of darkness, wire-like, and they were about one inch apart. The outlines were noticeably wavy but very clear and distinct. As totality approached they widened slightly until I should say they were about half an inch wide, but the distance apart did not seem to change noticeably. They were moving at moder-

ate speed. I judged one could easily keep up with them by running at a jog-trot, or slightly faster.

Raymond, who observed the shadow bands most persistently after his experience with the ruler, insists that they remained visible to him after the beginning of totality for he says he heard someone say, "There's the total eclipse" and he saw the bands for some time after that. It is possible, though, that someone said this when the corona first appeared before totality.

After totality the shadow bands were seen on the snowy background as soon as I looked for them, on the fading away of the corona, but now they had changed noticeably in appearance. Mr. Lewis and the young man I mentioned before, Raymond and myself, all agreed on this point. Mr. Lewis described them as like strips or panels. To me they appeared now to be two or three inches wide and about ten inches or a foot apart and much darker than before totality. Raymond wrote on the diagram of our surroundings that he made later, showing position of the shadow bands, the words, "broader and more distinct after totality." I believe this was his independent impression. All four of us stayed watching the shadow bands after the others had left the spot for fully five minutes, until they gradually faded away. Among letters I have received regarding the eclipse I was struck by one that describes the change in the appearance of the bands after totality, as we saw it. The writer of this letter described them as "about three to four inches wide with a broader much lighter band—about a foot wide—followed by another darker band and so on." Many did not look for them after totality. We who observed the shadow bands after totality for five minutes agreed that there was no change in direction aside from a possible slight westward shift.

After our return to Washington, and upon looking at the large scale map of the eclipse track in the pamphlet issued by the Nautical Almanac Office, I was struck by the fact that the wave fronts of the shadow bands, as we saw them, were advancing parallel to the line connecting the point on the center of line of total eclipse at any instant with the *corresponding* points on the northern and southern limiting curves respectively, in other words with the minor axis of the elliptical shadow spot as affected by the earth's rotation. Though undoubtedly an atmospheric phenomenon I cannot escape the belief that the shadow bands are in some way a function of the shadow-cone, either umbral or penumbral, and that their position is affected by the difference in the rate at which the observer is being carried eastward by the earth's rotation at different points within the limits of the path.

The darkness of totality was not great at our point of observation. I could easily see the hands of my watch and read some newspaper print pasted on the back of my drawing pad.

Venus was visible fully ten minutes before totality, Jupiter almost

immediately afterwards, then Mercury. No stars were observed, but the three planets shone magnificently during totality.

Rev. H. O. Du Bois writes concerning his observations of the shadow bands at Mt. Beacon, which differ from those of Mrs. Lewis, as follows:

"It may possibly be interesting for you to know that my observation of the shadow bands, made from the same point as Mrs. Lewis's observations, differed from hers, as to the apparent direction toward which they were moving. But she and those who corroborated her were looking at the *snow in a direction different* from that in which *I* was looking at it. Since the subject of shadow bands is a mystery yet, it may be that, if her eyes had been directed in the same direction as mine, she would have seen the shadows moving as I saw them. The facts are these:

"I was standing on top of a ledge of rock, and *looking directly at the sun.* Below the ledge, and directly between me and the sun, the shadow bands were moving on the snow across my line of vision,—I would say (regarding the sun as in the southeast) from S. E. by E. to N. W. by W. Mrs. Lewis and others who agreed with her were some yards away and looking at a snow field on the *west* side of the rock ledge. Looking thus, not toward the sun but perhaps southwest, she saw the bands moving from the southwest toward the northeast.

"In another letter received from her just now, she says, 'Where *we* say they (the bands) were coming *from* the general direction of the hotel, you say they were moving *toward* that direction.'

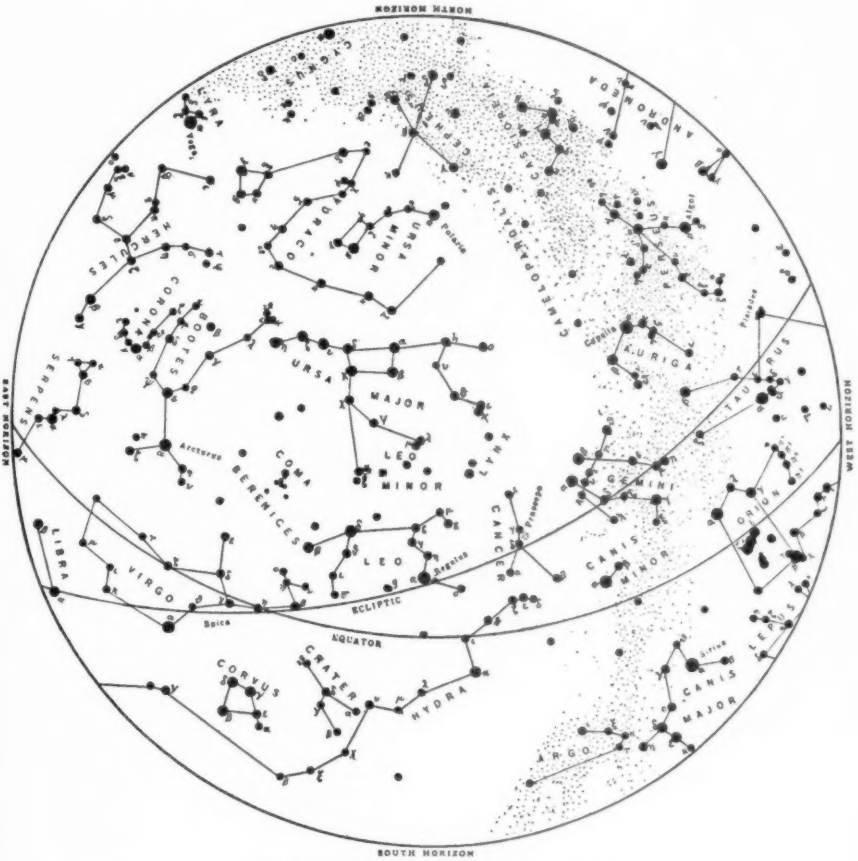
"The point I make is that, for all we know, this discrepancy of 180° may be the result, not of inaccurate observation, but of the different directions in which our eyes were looking.

"Mrs. Lewis observed the bands both before and after totality, but I looked for them only *before* totality."

[Other articles on the eclipse and the shadow bands are at hand and will appear in the April issue of POPULAR ASTRONOMY. See also the short eclipse notes in this issue on pp. 213-220. *Editors.*]

PLANET NOTES FOR APRIL

The *Sun* will be moving northward at the rate of about one minute of arc a day during the month. It will move from $0^h\ 40^m$, $+4°\ 16'$ to $2^h\ 30^m$, $+14°\ 51'$ and will pass from the constellation Pisces into the constellation Aries. The distance between the earth and the sun will be increasing, and on April 2 the distance will be equal to the average distance for the year.



THE CONSTELLATIONS AT 9:00 P. M. APRIL 1.

The phases of the *Moon* will occur as follows:

First Quarter	April	1 at	2 A.M.	C.S.T.
Full Moon		8 "	10 P.M.	"
Last Quarter		15 "	6 P.M.	"
New Moon		22 "	8 P.M.	"

The moon will be farthest from the earth on April 1 and nearest the earth on April 13.

Mercury at the beginning of the month will be near a point of greatest eastern elongation and probably can be seen just after sunset. It will soon move rapidly toward the sun, and on April 18 it will pass between the earth and the sun. It will not become visible again during the month.

Venus will begin the month about 20^m west of the sun. It will be moving eastward a bit more rapidly than the sun. On April 24 it will pass the sun on the opposite side from the earth. At the end of the month it will be 4^m east of the sun. Venus will therefore be invisible in the rays of the sun throughout this period.

Mars will cross the meridian about three o'clock in the afternoon. It will therefore be rather low in the west at sunset, and unfavorably situated for study. It will be receding from the earth and at the end of April will be about 200,000,000 miles away. Its stellar magnitude will be 1.7. It will be somewhat fainter than the first magnitude star Aldebaran, which closely resembles it as to color.

Jupiter will be in quadrature with the sun on April 11. At this time it will be on the meridian at sunrise and will be well situated for morning observations. The planet will, unfortunately for northern observers, be more than 21 degrees south of the equator.

Saturn will be visible late in the evening during this month. It will be 13 degrees south of the equator in the constellation Libra, a short distance northwest of Antares.

Uranus will be a short distance west of the sun, but too near for careful study.

Neptune will cross the meridian between 7 and 8 o'clock in the evening. It will still be in the constellation Leo.

Saturn's Satellites.

[From the *American Ephemeris.*]

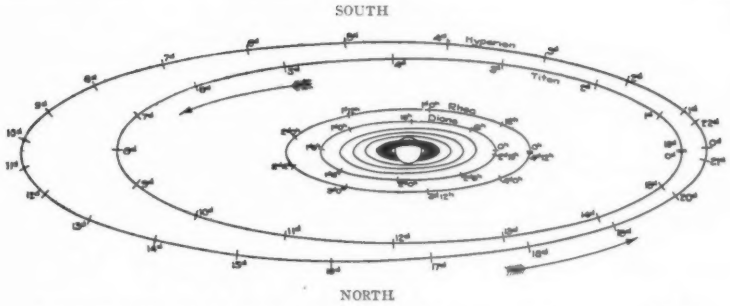
CENTRAL STANDARD TIME, MIDNIGHT = 0^h

I. Mimas. Period 0^d 22^{h}6.

1925	d	h		d	h	1925	d	h		d	h	
April	2	7.0	E	April 9	19.9	E	April 17	20.1	W	April 24	21.7	E
	3	5.7	E	11	5.9	W	19	6.1	E	25	20.3	E
	4	6.3	E	12	4.5	W	20	4.7	E	26	19.0	E
	5	2.9	E	13	3.1	W	21	3.3	E	27	6.3	W
	6	1.5	E	14	1.7	W	22	1.9	E	28	4.9	W
	7	0.1	E	15	0.3	W	23	0.5	E	29	3.5	W
	7	22.7	E	15	22.9	W	23	23.1	E	30	2.1	W
	8	21.3	E	16	21.5	W						

II. Enceladus. Period 1^d 8^{h}9.

April	1	8.0	E	April 9	13.3	E	April 19	3.4	E	April 25	23.8	E
	2	16.9	E	10	22.2	E	20	12.3	E	27	8 7	E
	4	1.7	E	12	7.0	E	21	21.2	E	28	17.5	E
	5	10.6	E	13	15.9	E	23	6.0	E	30	2.4	E
	6	19.5	E	15	0.8	E	24	14.9	E			
	8	4.4	E	17	18.5	E						



Apparent orbits of the seven inner satellites of Saturn at date of opposition, May 1, 1925, as seen in an inverting telescope.

III. Tethys. Period $1^d\ 21^h3$.

April	0	23.8	E	April	8	12.9	E	April	16	2.1	E	April	23	15.2	E
	2	21.1	E		10	10.2	E		17	23.4	E		25	12.5	E
	4	18.4	E		12	7.5	E		19	20.7	E		27	9.8	E
	6	15.7	E		14	4.8	E		21	18.0	E		29	7.1	E

IV. Dione. Period $2^d\ 17^h7$.

April	0	20.9	E	April	9	1.9	E	April	17	6.8	E	April	25	11.8	E
	3	14.6	E		11	19.5	E		20	0.5	E		28	5.4	E
	6	8.2	E		14	13.2	E		22	18.1	E				

V. Rhea. Period $4^d\ 12^h5$.

April	2	3.5	E	April	11	4.2	E	April	20	4.8	E	April	29	5.5	E
	6	15.8	E		15	16.5	E		24	17.1	E				

VI. Titan. Period $15^d\ 23^h3$.

April	5	11.5	W	April	13	8.5	E	April	21	8.9	W	April	29	6.0	E

VII. Hyperion. Period $21^d\ 7^h6$.

April	11	0.8	W	April	21	18.0	E				

VIII. Japetus. Period $79^d\ 22^h1$.

March	26	13.7	W	April	16	3.6	S	May	5	16.7	E

NOTE—E, Eastern Elongation; W, Western Elongation; S, Superior Conjunction; I, Inferior Conjunction.

Occultations Visible at Washington.

[*From the American Ephemeris*]

Date 1925	Star's Name	Magnitude	IMMERSION. Washington C.T.	IMMERSION. Angle from N	EMERSION. Washington C.T.	EMERSION. Angle from N	Duration
			h m	°	h m	°	h m
April 14	μ Sagittarii	4.0	1 42	104	2 56	276	1 14
17	114 B. Capricorni	6.1	2 28	117	3 21	228	0 53
20	10 H. Cancri	6.1	22 45	90	23 43	297	0 59

VARIABLE STARS.

Minima of Variable Stars of Short Period.

[Calculated by members of the classes in Astronomy at Carleton College.]

Given to the nearest hour in Greenwich civil time; to obtain Eastern Standard time subtract 5^h; Central Standard time 6^h, etc.

Star	R.A. 1900		Decl. 1900		Magnitude	Approx. Period		Greenwich civil times of minima in 1925 April							
	h	m	°	′		d	h	d	h	d	h	d	h	d	h
SY Androm.	0	08.0	+43	09	9.5—13.0	34	21.8			14	1				
RT Sculptor.		31.5	—26	13	9.6—10.5	0	12.3	1	1	8	17	16	9	24	1
U Cephei	0	52.4	+81	20	7.0— 9.0	1	11.8	3	4	10	15	18	3	25	14
Z Persei	2	33.7	+41	46	9.4—12	3	01.4	3	5	9	8	21	13	27	16
TW Cassiop.		37.6	+65	19	8.2— 9.0	1	10.3	9	13	18	3	26	16		
RY Persei		39.0	+47	43	8.0—10.3	6	20.7	7	5	14	2	20	22	27	19
RZ Cassiop.		39.9	+69	13	6.9— 8.1	1	04.7	1	23	9	3	23	11	30	16
TX Cassiop.		44.4	+62	22	9.4—10.1	2	22.2	3	14	13	9	22	4	30	23
ST Persei		53.7	+38	47	8.5—10.5	2	15.6	7	8	15	6	23	5		
RX Cassiop.	2	58.8	+67	11	8.6— 9.1	32	07.6					24	12		
Algol	3	01.7	+40	34	2.3— 3.5	2	20.8	2	5	10	19	19	9	28	0
RT Persei		16.7	+46	12	9.5—11.5	0	20.4	1	23	8	19	22	9	29	4
λ Tauri		55.1	+12	12	3.3— 4.2	3	22.9	1	19	9	17	17	14	25	12
RW Tauri	3	57.8	+27	51	7.1— [11	2	18.5	4	18	13	2	21	9	29	17
RV Persei	4	04.2	+33	59	9.5—11.0	1	23.4	1	16	9	13	17	10	25	8
RW Persei		13.3	+42	04	8.8—11.0	13	04.8	1	6	14	11	27	16		
SZ Tauri		31.4	+18	20	7.2— 7.7	3	03.6	2	18	9	1	21	16	27	23
RS Cephei	4	48.6	+80	06	9.5—12.0	12	10.1	4	11	16	21	29	7		
TT Aurigae	5	02.8	+39	27	7.8— 8.7	0	16.0	5	16	12	8	19	0	25	16
RY Aurigae		11.5	+38	13	10.7—11.7	2	17.5	7	21	16	1	24	6		
RZ Aurigae		42.9	+31	40	10.6—13.3	3	00.3	4	17	10	18	22	19	28	19
SV Tauri		45.8	+28	05	9.4—11.0	2	04.0	7	10	16	2	24	18		
Z Orionis		50.2	+13	40	9.7—10.7	5	04.9	3	1	13	11	23	21		
SV Gemin.		54.6	+24	28	9.8— [11	4	00.2	6	9	14	9	22	10	30	10
RW Gemin.	5	55.4	+23	08	9.5—11.0	2	20.8	5	5	10	23	22	10	28	4
U Columbæ	6	11.2	—33	03	9.2—10.0	2	19.2	6	12	12	3	23	7	28	22
SX Gemin.		22.0	+20	37	10.8—11.5	1	08.8	4	5	12	10	20	14	28	19
RW Monoc.		29.3	+ 8	54	9.0—10.8	1	21.7	4	18	12	9	20	0	27	15
RX Gemin.		43.6	+33	21	8.8— 9.6	12	05.0	4	18	16	23	29	4		
RU Monoc.	6	49.4	— 7	28	9.8—10.5	0	21.5	6	11	13	15	20	19	27	23
R Can. Maj.	7	14.9	—16	12	5.8— 6.4	1	03.3	2	23	11	19	23	10	30	5
RY Gemin.		21.7	+15	52	8.9— [10	9	07.2	6	4	15	11	24	18		
Y Cancelop.		27.6	+76	17	9.5—12	3	07.3	5	21	12	12	19	3	25	17
TX Gemin.		30.3	+17	08	10.0—11.9	2	19.2	1	5	9	14	18	0	26	10
RR Puppis		43.5	—41	08	9.4—10.7	6	10.3	1	17	8	4	21	0	27	11
V Puppis	7	55.4	—48	58	4.1— 4.8	1	10.9	2	2	9	8	16	15	23	21
X Carinae	8	29.1	—58	53	7.9— 8.7	0	13.0	4	16	12	18	20	21	29	0
S Cancri	8	38.2	+19	24	8.2—10	9	11.6	6	20	16	7	25	19		
RX Hydrae	9	00.8	— 7	52	9.1—10.5	2	06.8	7	18	14	14	21	11	28	7
S Velorum		29.4	—44	46	7.8— 9.3	5	22.4	1	10	7	8	19	5	25	4
Y Leonis	9	31.1	+26	41	9.3—11.2	1	16.5	5	6	12	0	18	18	25	12
RR Velorum	10	17.8	—41	36	10.0—10.9	1	20.5	3	21	11	7	18	17	26	3
SS Carinæ	10	54.2	—61	23	12.2—12.8	3	07.2	7	3	13	17	20	8	26	22
ST Urs. Maj.	11	22.4	+45	44	6.7— 7.2	8	19.2	7	16	16	12	25	7		
RW Urs. Maj.		35.4	+52	34	10.3—11.4	7	07.9	1	9	8	16	16	0	23	8
Z Draconis	11	39.8	+72	49	9.9—13.6	1	08.6	5	9	12	4	18	23	25	18
RZ Centauri	12	55.6	—64	05	8.5— 8.9	1	21.0	5	9	12	21	20	9	27	21
RS Can. Ven	13	06.3	+36	28	7.5—12.5	4	19.1			10	14	20	14	29	18
SS Centauri		07.2	—63	37	8.8—10.4	2	11.5	4	23	12	10	19	20	27	7
SX Hydræ	13	39.0	—26	23	8.6—12.7	2	21.5	1	18	13	8	19	3	30	17

Minima of Variable Stars of Short Period—Continued.

Star	R.A. 1900	Decl. 1900	Magnitude	Approx. Period	Greenwich civil times of minima in 1925 April							
	h m	° ′		d h	d h	d h	d h	d h	d h	d h	d h	d h
δ Libræ	14 55.6	— 8 07	4.8— 6.2	2 07.9	1 6	8 5	22 4	29 4				
U Coronæ	15 14.1	+32 01	7.6— 8.7	3 10.9	5 16	12 14	19 12	26 9				
TW Draconis	15 32.4	+64 14	7.3— 8.9	2 19.4	6 18	15 4	23 14					
SS Libræ	15 43.4	—15 14	9.3—11.5	0 18.4	1 4	8 9	22 18	29 23				
SW Ophiuchi	16 11.1	— 6 44	9.2—10.0	2 10.7	6 1	13 9	20 17	28 1				
SX Ophiuchi	12.6	— 6 25	10.5—11.2	2 01.5	6 5	14 11	22 17	30 23				
R Aræ	31.1	—56 48	6.8— 7.9	4 10.2	6 17	15 13	24 10					
TT Herculis	16 49.9	+17 00	8.9— 9.3	20 18.1		14 15						
TU Herculis	17 09.8	+30 50	9.5—12	2 06.4	2 14	9 9	22 23	29 19				
U Ophiuchi	11.5	+ 1 19	6.0— 6.7	0 20.1	2 11	10 20	19 6	27 15				
u Herculis	13.6	+33 12	4.6— 5.4	2 01.2	5 16	11 20	24 3	30 7				
TX Herculis	15.4	+42 00	8.3— 9.0	1 00.7	2 1	8 5	20 13	26 18				
RV Ophiuchi	29.8	+ 7 19	9. —12	3 16.5	7 15	15 0	22 9	29 18				
SZ Herculis	36.0	+33 01	9.5—10.3	0 19.6	6 23	15 4	23 8					
TX Scorpii	48.6	—34 13	7.5— 8.2	0 22.6	6 13	14 2	21 15	29 4				
UX Herculis	49.7	+16 57	8.8—10.5	1 13.2	2 4	9 22	17 15	25 9				
Z Herculis	53.6	+15 09	7.1— 7.9	3 23.8	5 16	13 16	21 16	29 15				
WX Sagittarii	53.6	—17 24	9.2—10.8	2 03.1	7 17	16 6	24 18					
WY Sagittarii	17 54.9	—23 01	9.5—10.6	4 16.0	5 3	14 11	19 3	28 11				
SX Draconis	18 03.0	+58 23	9.3—10.5	5 04.1	5 1	15 10	20 14	30 22				
RS Sagittarii	11.0	—34 08	5.9— 6.3	2 10.0	5 17	12 23	20 5	27 11				
V Serpentis	11.1	—15 34	9.5—11.1	3 10.9	4 7	11 5	18 3	25 1				
RZ Scuti	21.1	— 9 15	7.4— 8.3	15 03.2		14 4		29 7				
RZ Draconis	21.8	+58 50	9.5—10.2	0 13.2	3 2	10 6	17 10	24 14				
RX Herculis	26.0	+12 32	7.0— 7.6	0 21.3	6 19	13 22	21 1	28 3				
SX Sagittarii	39.7	—30 36	8.7— 9.8	2 01.8	1 20	10 3	18 11	26 18				
RR Draconis	40.8	+62 34	9.3—13	2 19.9	5 12	13 23	22 11	30 23				
RS Scuti	43.7	—10 21	9.3—10.3	0 15.9	6 13	13 5	19 23	26 12				
β Lyræ	46.4	+33 15	3.4— 4.1	12 21.8		11 5	24 3					
U Scuti	18 48.9	—12 44	9.1— 9.6	0 22.9	7 20	15 11	23 2	30 18				
RX Draconis	19 01.1	+58 35	9.3—10.2	1 21.4	5 10	12 23	20 13	28 3				
RV Lyræ	12.5	+32 15	11. —12.8	3 14.4	5 1	12 5	19 10	26 15				
RS Vulpec.	13.4	+22 16	6.9— 8.0	4 11.4	2 0	10 23	19 22	28 20				
U Sagittæ	14.4	+19 26	6.5— 9.0	3 09.1	6 2	12 20	19 15	26 9				
Z Vulpec.	17.5	+25 23	7.3— 8.5	2 10.9	7 19	15 4	22 12	29 21				
TT Lyræ	24.3	+41 30	9.4—11.6	5 05.8	2 4	12 16	17 22	28 9				
UZ Draconis	26.1	+68 44	9.0— 9.8	1 15.1	3 23	10 11	23 12	30 1				
SY Cygni	19 42.7	+32 28	10. —12	6 00.2	1 1	7 1	19 1	25 1				
WW Cygni	20 00.6	+41 18	9.3—13.4	3 07.6	3 6	9 22	23 4	29 19				
SW Cygni	03.8	+46 01	9. —11.7	4 13.8	3 4	12 7	21 11	30 15				
VW Cygni	11.4	+34 12	9.8—11.8	8 10.3	7 8	15 18	24 5					
RW Capric.	12.2	—17 59	8.8—10.6	3 09.4	2 18	9 13	23 2	29 21				
UW Cygni	19.6	+42 55	10.5—13	3 10.8	4 14	11 11	18 9	25 7				
V Vulpec	32.3	+26 15	8.2— 9.8	37 19.0								
W Delphini	33.1	+17 56	9.4—12.1	4 19.4	7 23	17 14	27 4					
RR Delphini	38.9	+13 35	10.5—11.8	4 14.4	9 17	18 22	28 2					
Y Cygni	48.1	+34 17	7.1— 7.9	1 12.0	8 18	17 17	26 17					
WZ Cygni	49.3	+38 27	9.9—10.8	0 14.0	7 3	14 18	22 8	29 23				
RR Vulpec	20 50.5	+27 32	9.6—11.0	5 01.2	2 9	12 11	22 14					
RY Aquarii	21 14.8	—11 14	8.8—10.4	1 23.2	8 12	16 9	24 6					
UZ Cygni	55.2	+43 52	8.9—11.6	31 07.3	7 17							
RT Lacertæ	21 57.4	+43 24	9.1—10.5	5 01.7	2 22	13 2	23 5					
RW Lacertæ	22 40.6	+49 08	10.2—11.2	5 04.4	1 18	11 20	16 21	26 23				
VW Pegasi	51.7	+32 42	10.0—10.6	5 06.4	1 21	12 10	17 17	28 5				
Y Piscium	23 29.3	+ 7 22	9.0—12.0	3 18.4	8 11	15 23	23 12					
TW Androm.	23 58.2	+32 17	8.6—11.5	4 02.9	8 2	16 8	24 14					

Maxima of Variable Stars of Short Period.

[Calculated by members of the classes in Astronomy at Carleton College.]

Given to the nearest hour in Greenwich civil time; to obtain Eastern Standard time subtract 5^h; Central Standard time 6^h, etc.

Star	R.A. 1900	Decl. 1900	Magnitude	Approx. Period	Greenwich civil times of maxima in 1925 April					
	h m	° ′		d h	d h	d h	d h	d h	d h	d h
SX Cassiop.	0 05.5	+54 20	8.6— 9.2	36 13.7						
SY Cassiop.	0 09.8	+57 52	9.3— 9.9	4 01.7	5 13	13 17	21 20	30 0		
RR Ceti	1 27.0	+ 0 50	8.3— 9.0	0 13.3	3 10	11 4	18 22	26 16		
RW Cassiop.	1 30.7	+57 15	8.9—11.0	14 19.2		14 20		29 15		
V Arietis	2 09.6	+11 46	8.3— 9.0	0 23.8	3 8	11 7	19 5	27 4		
SU Cassiop.	2 43.0	+68 28	6.5— 7.0	1 22.8	2 10	10 5	18 0	25 20		
RW Camelop.	3 46.2	+58 21	8.2— 9.4	16 00.0		13 16		30 2		
SX Persei	4 10.2	+41 27	10.4—11.2	4 07.0	5 18	14 8	22 22			
SV Persei	42.8	+42 07	8.8— 9.6	11 03.1		11 11	22 15			
RX Aurigæ	4 54.5	+39 49	7.2— 8.1	11 15.0	4 11	16 2	27 17			
SX Aurigæ	5 04.6	+42 02	8.0— 8.7	1 12.8	8 11	16 2	23 18			
SY Aurigæ	05.5	+42 41	8.4— 9.5	10 03.3	9 18	19 21	30 1			
Y Aurigæ	21.5	+42 21	8.6— 9.6	3 20.6	2 17	10 10	18 4	25 21		
RZ Gemin.	5 56.6	+22 15	9.1—10.0	5 12.7	5 21	11 10	22 12	28 1		
RS Orionis	6 16.5	+14 44	8.2— 8.9	7 13.6	4 3	11 16	19 6	23 20		
T Monoc.	19.8	+ 7 08	5.7— 6.8	27 00.3	6 3					
R Aurigæ	23.0	+30 33	5.1— 6.0	3 17.5	1 9	8 20	16 7	23 17		
W Gemin.	29.2	+15 24	6.7— 7.5	7 22.0	4 9	13 7	21 5	29 3		
ζ Gemin.	6 58.2	+20 43	3.7— 4.3	10 03.7	3 23	14 3	24 7			
RU Camelop	7 10.9	+69 51	8.5— 9.8	22 06.5		15 23				
RR Gemin.	7 15.2	+31 04	10.0—11.5	0 09.5	4 3	12 2	20 1	27 23		
V Carinae	8 26.7	—59 47	7.4— 8.1	6 16.7	5 10	12 3	18 20	25 12		
T Velorum	8 34.4	—47 01	7.6— 8.5	4 15.3	5 1	14 7	18 22	28 5		
V Velorum	9 19.2	—55 32	7.5— 8.2	4 08.9	3 18	12 12	21 5	29 23		
Z Leonis	9 46.4	+27 22	7.9— 9.6	56 08.7			19 2			
RR Leonis	10 02.1	+24 29	9.1—10.1	0 10.9	2 4	8 23	22 12	29 7		
SU Draconis	11 32.2	+67 53	8.9— 9.6	0 15.8	4 23	11 14	18 4	24 19		
S Muscae	12 07.4	—69 36	6.4— 7.3	9 15.8	1 9	11 1	20 16	30 8		
SW Draconis	12.8	+70 04	8.8— 9.6	0 13.7	2 23	10 22	18 22	26 21		
T Crucis	15.9	—61 44	6.8— 7.6	6 17.6	4 5	10 22	17 16	24 9		
R Crucis	18.1	—61 04	6.8— 7.9	5 19.8	1 17	7 13	19 4	25 0		
S Crucis	12 48.4	—57 53	6.5— 7.6	4 16.6	2 2	11 11	16 3	25 12		
W Virginis	13 20.9	— 2 52	8.7—10.4	17 06.5	4 20		22 3			
SS Hydræ	25.0	—23 08	7.4— 8.1	8 04.8	1 17	9 22	18 3	26 7		
RV Urs. Maj.	13 29.4	+54 31	9.2— 9.9	0 11.2	2 22	9 22	16 23	23 23		
ST Virginis	14 22.5	— 0 27	10.3—11.4	0 09.9	8 4	15 13	22 23	30 9		
V Centauri	25.4	—56 27	6.4— 7.8	5 11.9	3 20	9 8	20 8	25 20		
RS Bootis	29.3	+32 11	8.9—10.0	0 09.1	3 0	10 13	18 3	25 16		
R Triang.Austr.	15 10.8	—66 08	6.7— 7.4	3 09.3	6 19	13 14	20 8	27 3		
S Triang.Austr.	15 52.2	—63 29	6.4— 7.4	6 07.8	2 0	8 8	20 23	27 7		
S Normæ	16 10.6	—57 39	6.6— 7.6	9 18.1	5 2	14 20	24 14			
RW Draconis	33.7	+58 03	9.6—10.8	0 10.6	5 18	14 14	23 11			
RV Scorpii	16 51.8	—33 27	6.7— 7.4	6 01.5	6 4	12 5	24 8	30 10		
X Sagittarii	17 41.3	—27 48	4.4— 5.0	7 00.3	7 0	14 0	21 0	28 1		
Y Ophiuchi	47.3	— 6 07	6.1— 6.5	17 02.9		16 11				
W Sagittarii	17 58.6	—29 35	4.3— 5.1	7 14.3	2 23	10 13	18 3	25 17		
Y Sagittarii	18 15.5	—18 54	5.4— 6.2	5 18.6	3 21	9 15	21 5	26 23		
U Sagittarii	26.0	—19 12	6.5— 7.3	6 17.9	2 11	9 4	22 16	29 10		
Y Scuti	32.6	— 8 27	8.7— 9.2	10 08.3	2 14	12 22	23 6			
RZ Lyræ	39.9	+32 42	9.9—11.2	0 12 3	7 14	15 6	22 22	30 14		
RT Scuti	18 44.1	—10 30	9.1— 9.7	0 11.9	1 7	8 18	16 4	23 15		
κ Pavonis	18 46.6	—67 22	3.8— 5.2	9 02.2	7 21	16 23	26 1			
U Aquilæ	19 24.0	— 7 15	6.2— 6.9	7 00.6	5 16	12 16	19 17	26 18		

Maxima of Variable Stars of Short Period—Continued.

Star	R.A. 1900	Decl. 1900	Magnitude	Approx. Period	Greenwich civil times of maxima in 1925							
					April							
	h m	° ′		d h	d h	d h	d h	d h	d h	d h	d h	d h
XZ Cygni	19 30.4	+56 10	8.6— 9.3	0 11.2	6 6	13 6	20 6	27 6				
U Vulpec.	32.2	+20 07	6.5— 7.6	7 23.5	6 14	14 14	22 13	30 13				
SU Cygni	40.8	+29 01	6.2— 7.0	3 20.3	7 2	14 18	22 11	30 3				
η Aquilæ	47.4	+ 0 45	3.7— 4.5	7 04.2	2 5	9 9	16 13	23 18				
S Sagittæ	51.5	+16 22	5.6— 6.4	8 09.2	5 16	14 1	22 10					
X Vulpec.	19 53.3	+26 17	9.5—10.5	6 07.7	3 20	10 4	22 19	29 3				
X Cygni	20 39.5	+35 14	6.0— 7.0	16 09.3	8 21		25 6					
T Vulpec.	47.2	+27 52	5.5— 6.1	4 10.5	1 20	10 17	19 14	28 11				
UY Cygni	52.3	+30 03	9.6—10.4	0 13.5	3 6	9 23	16 17	23 10				
RV Capric.	55.9	—15 37	9.2—10.1	0 10.7	2 3	8 20	22 6	29 0				
TX Cygni	20 56.4	+42 12	8.5— 9.7	14 17.4	7 8		22 1					
VY Cygni	21 00.4	+39 34	8.8— 9.5	7 20.6	5 10	13 7	21 3	29 0				
SW Aquarii	10.2	— 0 20	9.9—10.8	0 11.0	2 2	8 23	22 18	29 15				
VZ Cygni	21 47.7	+42 40	8.2— 9.2	4 20.7	5 9	15 2	19 23	29 17				
Y Lacertæ	22 05.2	+50 33	9.1— 9.6	4 07.8	1 18	10 10	19 2	27 17				
δ Cephei	25.5	+57 54	3.7— 4.6	5 08.8	2 9	13 3	18 11	29 5				
Z Lacertæ	36.9	+56 18	8.2— 9.0	10 21.1	7 5	18 3	29 0					
RR Lacertæ	37.5	+55 55	8.5— 9.2	6 10.1	2 19	9 5	22 1	28 11				
V Lacertæ	44.5	+55 48	8.5— 9.5	4 23.6	5 23	10 22	20 21	25 21				
X Lacertæ	22 45.0	+55 54	8.2— 8.6	5 10.7	1 17	12 15	18 1	28 22				
SW Cassiop.	23 03.7	+58 11	9.2— 9.7	5 10.6	4 5	9 16	20 13	26 0				
RS Cassiop.	32.6	+61 52	9.0—11.0	6 07.1	6 2	12 9	18 16	24 23				
RY Cassiop.	47.2	+58 11	9.3—11.8	12 03.4	7 2		19 5					
V Cephei	23 51.7	+82 38	6.0— 7.0	0 23.9	6 20	13 19	20 19	27 19				

Monthly Report of the American Association of Variable Star Observers, Received During January, 1925.

In spite of the excessive amount of cloudy weather which has prevailed in many localities, we are able to present herewith a very commendable list of observations. Reports have come from many of our members regarding the success of the recent total eclipse of the sun, and these will in due time be turned over to the National Research Council for their perusal and discussion. Although many excellent photographs and observations have been secured, those of Mr. Wm. Henry, taken at the Observatory at Southold, L. I., deserve more than passing mention. All members who made any worth-while observations of this eclipse are requested to send to the undersigned, Chairman of the A. A. V. S. O. Eclipse Committee, any prints, slides, drawings or facts of interest which they may have secured.

In conformity with the plans outlined at the October meeting of the Association, it will be noted that all observations made prior to January 1, 1925—J. D. 2424152—have been referred to the old astronomical time—Greenwich Mean Noon—while those made on and after that date are referred to Greenwich Civil Time which begins at midnight. While this innovation appears to have met with some opposition from foreign observers—not members of the Association—it is felt that the scheme should be adhered to in order that the change from one kind of time to the other may be made as complete as possible.

VARIABLE STAR OBSERVATIONS RECEIVED DURING JANUARY, 1925.

November 1, 1924 = J. D. 2424091 — January 1, 1925 = J. D. 2424152

December 1, 1924 = J. D. 2424121

Star	J.D.	Est.	Obs.	J.D.	Est.	Obs.
000339 V SCULPTORIS—						
	4088.0	7.6	Kd	4113.4	6.7	Sm
001032 S SCULPTORIS—						
	4084.0	7.6	Kd	4111.9	7.0	Kd
	4098.1	10.9	Bl	4107.6	11.2	Bl
	4091.9	7.2	Kd	4113.9	7.1	Kk
	4092.0	7.7	Kk	4113.9	7.3	Ht
	4093.3	7.3	Sm	4114.0	6.9	Kd
	4098.1	7.0	Bl	4116.9	7.0	Kk
	4101.3	7.0	Ht	4118.9	7.0	Kk
	4104.9	7.3	Kk	4117.9	7.0	Kd
	4105.3	7.1	Ht	4120.3	7.1	Ht
	4106.0	7.1	Kd	4121.0	6.9	Kd
	4107.0	7.0	Bl	4132.9	7.2	Kd
	4107.4	6.9	Sm	4137.0	7.3	Kd
	4109.9	7.2	Kk	4140.9	7.5	Kd
	4111.0	6.9	Kd			
001046 X ANDROMEDAE—						
	4085.6	9.9	Wf	4146.6	[11.5	Al
	4119.6	11.5	Wf	4157.1	12.5	Bi
	4139.6	12.0	Lv	4159.0	12.7	B
	4150.6	12.4	Lv	4165.0	12.7	Bi
	4146.6	10.5	Hu	4166.1	12.9	Ie
001620 T CETI—						
	4087.9	6.6	Kd	4116.9	6.3	Kk
	4091.9	6.4	Kk	4117.1	6.3	Kd
	4095.1	6.3	Kk	4118.9	6.5	Kd
	4098.9	6.5	Kd	4121.0	6.3	Kd
	4104.9	6.5	Kk	4130.9	6.5	Kd
	4105.9	6.6	Kd	4137.0	6.5	Kd
	4108.0	6.5	Kd	4140.2	6.6	L
	4111.0	6.6	Kd	4140.9	6.5	Kd
	4111.9	6.7	Kd	4144.9	6.4	Kd
	4113.9	6.4	Kk			
001726 T ANDROMEDAE—						
	4112.0	8.5	Ch	4152.1	8.3	B
	4121.2	7.8	Ch	4157.2	8.5	Bi
	4146.5	8.2	Pt	4165.0	9.0	Bi
	4148.5	8.2	Ie	4175.3	8.7	Mz
	4150.6	8.5	Lv			
001755 T CASSIOPEIAE—						
	4138.5	7.6	Mz	4146.6	7.0	Ly
	4142.7	7.5	Sg	4156.2	7.6	Ie
	4146.5	7.7	Du	4162.2	7.5	Sg
	4146.5	7.3	Pt	4175.1	7.8	Mz
001838 R ANDROMEDAE—						
	4085.6	14.1	Wf	4134.6	[12.4	Cy
	4112.0	[11.6	Ch	4140.6	[13.9	Ie
	4119.6	14.8	Wf	4146.5	14.3	Pt
001862 S TUCANAE—						
	4093.3	9.0	Sm	4107.4	8.9	Sm
	4098.1	8.5	Bl	4113.4	9.0	Sm
	4107.0	8.8	Bl			
001909 S CETI—						
	4100.1	9.2	Ch	4140.2	11.5	L
	4112.0	10.1	Ch	4146.5	11.8	Pt
	4137.6	11.4	Sg	4163.1	11.5	Sg
	4138.5	11.5	Mz	4166.0	[12.5	Ie
002546 T PHOENICIS—						
	4107.4	[12.2	Sm	4109.0	[13.6	Bl
002833 W SCULPTORIS—						
	4109.0	13.3	Bl			
003179 Y CEPHEI—						
	4146.6	10.5	Hu	4147.5	10.5	Ie
004047 U CASSIOPEIAE—						
	4085.6	8.5	Wf	4150.6	8.7	Bi
	4119.6	8.2	Wf	4152.1	7.8	B
	4138.5	8.9	Mz	4157.2	9.1	Bi
	4140.6	8.7	Lv	4157.3	9.9	Mz
	4140.6	8.5	Ie	4162.2	9.5	Sg
	4142.7	8.3	Sg	4168.1	10.8	Ie
	4146.5	8.7	Pt			
004132 RW ANDROMEDAE—						
	4121.2	8.5	Ch	4157.1	8.7	Mz
	4142.6	8.2	Ie	4159.1	[8.7	B
	4146.5	8.3	Pt			
004435 V ANDROMEDAE—						
	4109.0	13.0	Bl	4152.1	10.5	B
	4140.6	10.8	Bi	4157.2	9.8	Bi
	4146.6	10.5	Hu	4167.1	9.7	B
	4150.6	10.3	Bi			
004533 RR ANDROMEDAE—						
	4085.6	9.7	Wf	4159.1	12.0	B
	4119.6	10.4	Wf			
004746a RV CASSIOPEIAE—						
	4085.6	9.6	Wf	4146.5	10.9	Pt
	4119.6	10.7	Wf	4159.1	12.0	B
	4138.6	11.2	B	4167.1	12.9	Ie
	4141.6	11.6	Ie	4168.1	11.6	Ie
	4146.5	11.5	Pt			
004746b — CASSIOPEIAE—						
	4141.6	10.6	Ie			
004958 W CASSIOPEIAE—						
	4139.6	11.2	B	4159.1	11.7	B
	4146.5	12.0	Pt			
005475 U TUCANAE—						
	4091.3	8.9	Sm	4107.4	9.5	Sm
	4098.1	10.3	Bl	4113.3	9.9	Sm
	4107.0	10.2	Bl			
005840 RX ANDROMEDAE—						
	4141.5	12.4	Pt	4158.0	[11.0	Pt
	4142.6	12.6	Pt	4160.0	[12.4	Pt
	4144.5	12.4	Pt	4161.0	11.7	Pt
	4145.5	12.4	Pt	4065.0	10.9	Pt
	4146.6	13.3	Pt	4166.0	11.2	Pt
	4149.7	[11.7	Pt	4170.2	[12.4	Pt
010102 Z CETI—						
	4146.5	11.8	Pt			
010630 U SCULPTORIS—						
	4098.1	10.3	Bl	4107.0	10.2	Bl
010940 V ANDROMEDAE—						
	4085.6	14.1	Wf	4142.6	[13.1	Ie
	4119.6	14.5	Wf			

VARIABLE STAR OBSERVATIONS RECEIVED DURING JANUARY, 1925—Continued.

Star	J.D.	Est.	Obs.	J.D.	Est.	Obs.
011041 UZ ANDROMEDAE—						
	4085.6	11.3	Wf	4152.1	11.9	B
	4119.6	11.3	Wf	4167.1	12.9	B
	4142.6	11.9	Ie			
011272 S CASSIOPEIAE—						
	4075.6	14.3	Wf	4142.7	[12.3	Sg
	4185.6	13.4	Wf	4150.6	12.7	Bi
	4119.6	12.5	Wf	4152.1	12.4	B
	4158.2	12.5	Bi	4166.1	12.5	Ie
	4140.6	12.6	Bi			
011712 U PISCIUM—						
	4146.5	12.2	Pt			
012233a R SCULPTORIS—						
	4088.0	7.8	Kd	4121.0	7.7	Kd
	4108.0	7.8	Kd	4137.0	7.4	Kd
012350 RZ PERSEI—						
	4155.1	10.1	B			
012502 R PISCIUM—						
	4138.5	11.5	Mz	4158.1	[12.3	Bi
	4139.7	11.7	Lv	4160.9	[12.3	Bi
	4150.6	13.0	Lv			
013238 RU ANDROMEDAE—						
	4119.6	12.0	Wf	4146.5	13.5	Pt
	4121.2	[11.1	Ch	4147.6	[13.0	Ie
	4143.7	13.2	B	4165.2	[13.0	B
013338 Y ANDROMEDAE—						
	4121.2	9.6	Ch	4155.1	11.8	B
	4146.5	11.2	Pt			
014958 X CASSIOPEIAE—						
	4146.5	10.6	Pt	4159.1	10.6	B
015354 U PERSEI—						
	4142.6	8.7	Sg	4159.1	8.7	B
	4146.5	8.5	Pt			
015912 S ARIETIS—						
	4146.5	11.8	Pt	4155.2	11.9	B
021024 R ARIETIS—						
	4091.9	9.3	Kk	4139.7	8.9	Lv
	4096.8	8.8	Kk	4140.6	8.4	Ie
	4104.9	8.4	Kk	4140.6	8.4	Jo
	4106.9	8.2	Kk	4141.6	8.4	Ly
	4108.9	8.0	Kk	4150.6	9.2	Lv
	4109.9	8.1	Kk	4157.2	9.8	Bi
	4110.0	8.0	Kk	4158.0	10.0	Mz
	4111.9	7.9	Kk	4158.2	10.2	Cy
	4113.1	7.9	Kk	4165.0	10.2	Bi
	4116.8	8.0	Kk	4165.1	10.1	B
	4119.6	8.6	Wf	4167.0	10.5	Ly
	4138.5	8.2	Mz	4169.0	10.3	Ly
021143a W ANDROMEDAE—						
	4085.6	9.6	Wf	4111.9	7.5	Kk
	4091.9	9.4	Kk	4112.0	7.3	Nk
	4096.8	9.3	Kk	4113.0	7.4	Nk
	4106.3	7.5	Nk	4116.8	7.2	Kk
	4106.9	7.9	Kk	4119.6	7.2	Wf
	4107.0	7.5	Nk	4146.5	7.6	Pt
	4108.0	7.4	Nk	4156.1	7.5	Ie
	4109.0	7.5	Nk	4159.1	7.0	B
021258 T PERSEI—						
	4122.1	9.0	Ch	4146.5	8.4	Pt
021281 Z CEPHEI—						
	4147.5	[13.0	Ie			
021403 o CETI—						
	4095.0	8.1	Kk	4140.5	3.8	Ms
	4100.1	7.8	Ch	4140.5	4.0	Cy
	4103.1	7.3	Ch	4140.6	4.5	Jo
	4105.1	7.2	Ch	4140.9	3.8	Kd
	4105.9	7.6	Kk	4141.5	3.9	Ms
	4106.0	7.2	Nk	4141.6	4.0	Cy
	4107.0	7.2	Nk	4142.6	4.0	Cy
	4108.0	7.3	Nk	4143.0	3.7	Kd
	4108.9	6.8	Kd	4143.5	3.9	Ms
	4109.0	7.2	Nk	4143.9	3.9	Kd
	4109.9	7.2	Kk	4144.6	4.0	Ly
	4111.0	6.7	Kd	4144.6	3.9	Sg
	4111.9	6.5	Kd	4145.5	4.2	Wf
	4112.0	6.9	Nk	4145.6	4.1	Ly
	4112.1	5.8	Ch	4146.5	3.9	Ms
	4113.0	6.7	Nk	4146.5	4.0	Pt
	4113.1	6.8	Kk	4146.6	3.9	Cy
	4114.0	6.0	Kd	4148.5	4.0	Ly
	4115.9	5.8	Kd	4148.5	3.9	Ms
	4116.9	6.1	Kk	4148.1	4.0	Ho
	4117.1	5.9	Kd	4149.8	4.0	Ho
	4117.9	5.9	Kd	4150.2	3.6	L
	4118.9	5.7	Kd	4150.5	4.0	Ly
	4119.1	5.1	Ch	4151.0	3.6	Ms
	4119.6	5.4	Wf	4157.0	3.5	Ms
	4121.0	5.5	Kd	4158.2	3.7	Cy
	4121.9	5.5	Kd	4160.0	3.8	Cy
	4122.1	4.9	Ch	4160.0	3.6	Ms
	4123.9	5.0	Kd	4162.1	3.7	Sg
	4125.0	4.9	Ch	4163.0	3.9	Ly
	4127.9	5.1	Kd	4165.0	3.6	Pt
	4130.9	4.8	Kd	4165.0	4.0	Ly
	4131.9	4.7	Kd	4166.0	3.6	Ms
	4132.9	4.5	Kd	4166.0	3.7	Cy
	4133.7	4.4	Cy	4166.0	3.8	Ly
	4134.5	4.2	Ms	4167.0	4.2	Jo
	4136.0	4.8	Kd	4167.0	3.6	Ms
	4137.0	4.1	Kd	4167.0	4.0	Ly
	4137.0	4.2	Kd	4167.0	4.0	Ly
	4137.0	4.7	Kd	4169.0	3.8	Ly
	4140.2	3.8	L	4170.0	3.7	Ms
021558 S PERSEI—						
	4122.1	9.9	Ch	4165.0	10.5	Pt
	4133.0	10.2	Kl	4167.2	10.0	B
	4146.5	9.2	Pt			
023000 R CETI—						
	4138.5	6.2	Mz			
022150 RR PERSEI—						
	4146.6	[13.5	Ie	4167.1	[13.4	B
022426 R FORNACIS—						
	4098.1	8.6	Bl	4109.0	8.8	Bl
	4107.0	9.5	Bl			
022813 U CETI—						
	4092.0	7.8	Kk	4119.2	8.4	Ch
	4095.0	7.5	Kk	4146.5	9.4	Pt
	4096.1	7.6	Kk			
022980 RR CEPHEI—						
	4147.5	12.7	Ie			

VARIABLE STAR OBSERVATIONS RECEIVED DURING JANUARY, 1925—Continued.

Star	J.D.	Est.Obs.	J.D.	Est.Obs.
023133 R TRIANGULI—				
	4091.9	7.4 Kk	4137.7	5.8 Cy
	4092.9	7.4 Kk	4138.5	6.2 Mz
	4094.8	7.4 Kk	4140.7	6.2 Lv
	4096.1	7.4 Kk	4146.5	6.3 Pt
	4104.9	7.1 Kk	4150.6	6.2 Bi
	4109.9	7.0 Kk	4156.1	6.1 Ie
	4113.8	6.9 Kk	4157.1	6.2 Mz
	4116.8	6.8 Kk	4157.2	6.5 Bi
	4121.0	6.6 Kd	4165.0	6.6 Bi
024356 W PERSEI—				
	4093.0	10.1 Nk	4112 0	10.1 Nk
	4094.0	10.0 Nk	4113.0	10.0 Nk
	4097.0	10.0 Nk	4138.6	9.3 Mz
	4101.0	10.0 Nk	4140.7	9.5 Cy
	4105.0	10.0 Nk	4146.5	9.0 Pt
	4106.0	10.0 Nk	4146.6	9.3 Cy
	4107.0	10.0 Nk	4158.0	9.2 Mz
	4108.0	10.0 Nk	4166.0	9.2 Cy
	4109.0	10.0 Nk	4167.2	[8.6 B
025050 R HOROLOGII—				
	4091.6	6.8 Sm	4107.0	6.9 Bl
	4098.1	6.7 Bl	4111.3	7.5 Sm
	4104.3	7.1 Ht	4113.3	7.6 Ht
	4105.3	7.3 Ht	4116.3	7.6 Sm
	4105.3	7.5 Sm	4120.3	7.8 Ht
025751 T HOROLOGII—				
	4093.3	10.8 Sm	4107.0	9.6 Bl
	4098.1	10 3 Bl	4111.3	9.3 Sm
	4105.3	9.8 Sm	4116.3	9.0 Sm
030514 U ARIETIS—				
	4165.2	[13.5 B		
031401 X CETI—				
	4140.3	9.6 L	4165.1	8.5 B
	4146.5	8.6 Pt		
032043 Y PERSEI—				
	4093.0	9.2 Nk	4109.0	10.3 Nk
	4095.1	9.8 Nk	4111.0	10.3 Nk
	4105.0	10.3 Nk	4112.0	10.3 Nk
	4106.0	10.1 Nk	4113.0	10.1 Nk
	4107.0	10.1 Nk	4146.5	10.1 Pt
	4108.0	10.2 Nk		
032335 R PERSEI—				
	4142.5	8.5 Ie	4167.2	9 3 B
	4146.5	8.4 B		
032443 NOVA PERSEI #3—				
	4107.0	14.3 Nk	4109.0	14.5 Nk
042209 R TAURI—				
	4120.2	[10.6 Ch	4146.6	13.6 Ie
042215 W TAURI—				
	4138.6	10.3 Mz	4146.5	9.9 Du
	4140.6	10.4 Mh	4150.6	9.6 B
	4144.6	9.4 Sg	4162.1	10.4 Sg
	4144.7	9.5 Pt	4169.0	[10.4 Mh
042309 S TAURI—				
	4120.2	[10.6 Ch	4146.6	13.5 Ie
	4142.5	[10.6 Mz		
043065 T CAMELOPARDALIS—				
	4144.7	13.0 Pt		
043208 RX TAURI—				
	4140.5	12.1 B	4158.2	11.9 Bi
	4140.7	12.2 Lv	4161.0	11.8 B
	4150.7	12.0 Lv		
043363 R RETICULI—				
	4091.3	10.5 Sm	4107.0	9.8 Bl
	4098.1	10.0 Bl	4111.3	9.3 Sm
	4101.3	10.4 Ht	4113.3	9.3 Ht
	4105.3	10.1 Ht	4116.3	8.6 Sm
	4105.3	9.8 Sm	4120.3	8.9 Ht
043274 X CAMELOPARDALIS—				
	4147.6	10.9 Ie	4161.0	11.5 B
043562 R DORADUS—				
	4091.3	5.8 Sm	4107.0	6.1 Bl
	4098.1	5.7 Bl	4111.3	5.8 Sm
	4101.3	6.4 Ht	4116.3	5.8 Sm
	4105.3	6.4 Ht	4120.3	6.4 Ht
	4105.3	5.8 Sm		
043738 R CAELI—				
	4101.3	[11.2 Ht	4113.3	[11.7 Ht
	4105.3	[11.7 Ht	4120.3	[11.7 Ht
	4109.1	12.5 Bl		
044349 R PICTORIS—				
	4098.1	7.6 Bl	4107.1	7.5 Bl
044617 V TAURI—				
	4140.5	12.4 B	4146.6	12.7 Ie
	4144.7	12.5 Pt	4161.0	12.8 B
045307 R ORIONIS—				
	4148.6	11.6 Ie	4150.6	11.3 B
045514 R LEPORIS—				
	4093.1	8.6 Kk	4144.7	6.8 Pt
	4095.0	8.5 Kk	4146.6	7.8 Ly
	4101.2	8.0 Ch	4147.9	7.8 Ho
	4107.1	7.8 Nk	4148.8	7.7 Ho
	4108.1	7.8 Nk	4149.9	7.8 Ho
	4112.8	8.3 Ch	4152.1	6.9 B
	4113.1	8.4 Kk	4167.1	6.1 B
	4116.0	8.3 Kk	4169.1	7.4 Ly
	4142.7	7.3 Jo		
050003 V ORIONIS—				
	4123.1	9.2 Ch	4147.7	8.9 Ie
	4142.5	8.9 Mz	4152.0	9.0 B
	4144.7	9.0 Pt		
050022 T LEPORIS—				
	4098.1	10.4 Bl	4144.7	9.1 Pt
	4107.1	10.6 Bl	4152.1	8.0 B
050848 S PICTORIS—				
	4091.3	[11.4 Sm	4111.3	[12.2 Sm
	4105.3	12.2 Sm	4116.3	12.2 Sm
	4109.1	12.4 Bl		
050953 R AURIGAE—				
	4139.6	12.2 B	4157.2	11.8 Bi
	4142.5	12.8 Ie	4161.0	11.3 B
	4142.6	[11.5 Mz	4167.2	11.7 Ie
	4144.7	12 8 Pt		
051247 T PICTORIS—				
	4091.3	10.6 Sm	4107.1	12.0 Bl
	4098.1	10.7 Bl	4111.3	11.8 Sm
	4105.3	11.5 Sm	4113.3	12.0 Ht
	4105.3	11.8 Ht	4120.3	12.5 Ht

VARIABLE STAR OBSERVATIONS RECEIVED DURING JANUARY, 1925—Continued.

Star	J.D.	Est.	Obs.	J.D.	Est.	Obs.
051533 T COLUMBAE—						
	4091.3	8.4	Sm	4107.1	8.2	Bl
	4098.1	8.2	Bl	4111.3	7.8	Sm
	4101.4	8.4	Ht	4113.3	7.8	Ht
	4105.3	8.4	Ht	4116.3	7.8	Sm
	4105.3	8.1	Sm	4120.3	7.5	Ht
052034 S AURIGAE—						
	4119.2	9.3	Ch	4144.7	7.5	Pt
	4142.7	9.0	Sg	4163.1	8.9	Sg
052036 W AURIGAE—						
	4119.2	11.0	Ch	4140.6	[12.0	Ie
052404 S ORIONIS—						
	4144.7	7.5	Pt	4165.0	7.5	Pt
	4152.1	7.5	B	4167.1	7.9	B
053005a T ORIONIS—						
	4093.2	11.0	Nk	4146.6	9.8	Pt
	4095.1	11.0	Nk	4146.6	10.6	Hu
	4105.1	11.0	Nk	4147.6	9.7	Pt
	4106.0	11.0	Nk	4149.7	9.7	Pt
	4107.0	11.0	Nk	4150.6	10.0	B
	4108.0	11.0	Nk	4156.0	10.4	Pt
	4109.0	11.1	Nk	4158.0	10.4	Pt
	4112.0	11.1	Nk	4160.0	10.4	Pt
	4113.1	11.1	Nk	4161.1	11.2	B
	4142.6	9.8	Pt	4165.0	10.1	Pt
	4144.7	9.9	Pt	4166.0	10.1	Pt
	4145.5	10.0	Pt	4167.1	10.2	Pt
053068 S CAMELOPARDALIS—						
	4114.7	9.1	Pt			
053326 RR TAURI—						
	4138.6	12.6	B	4157.0	[12.6	B
	4144.6	13.5	B			
053337 RU AURIGAE—						
	4142.7	[12.1	Sg	4163.1	[11.6	Sg
053531 U AURIGAE—						
	4119.2	10.4	Ch	4161.1	11.7	B
	4139.6	11.5	B	4166.1	12.6	Ie
	4144.7	11.4	Pt			
054319 SU TAURI—						
	4119.2	12.1	Ch	4149.7	11.2	Pt
	4119.6	12.6	Wf	4150.5	11.5	Pt
	4137.7	11.5	B	4150.7	11.6	Lv
	4139.6	11.6	B	4153.1	10.7	B
	4140.5	11.8	Ie	4156.0	10.8	Pt
	4140.6	11.9	Du	4157.1	10.7	B
	4141.5	12.0	Pt	4157.2	10.9	Bi
	4142.6	11.4	Ie	4158.0	11.2	Pt
	4142.6	11.8	Pt	4158.2	11.3	Wf
	4143.6	11.3	B	4160.0	11.0	Pt
	4144.5	11.2	Pt	4160.1	10.6	Lv
	4145.5	11.4	Pt	4161.0	[10.1	Pt
	4146.5	11.7	Du	4165.0	11.0	Pt
	4146.6	11.0	Pt	4166.0	11.1	Pt
	4146.7	12.2	Bi	4166.1	10.7	Ie
	4147.6	11.0	Pt	4169.1	9.9	Ly
	4146.6	11.4	Du	4170.1	[11.0	Ks
	4146.6	11.4	Ie	4170.2	10.5	Pt
054331 S COLUMBAE—						
	4105.3	[12.2	Ht	4113.3	[12.2	Ht
	4109.1	13.1	Bl	4120.3	[12.6	Ht
054615a Z TAURI—						
	4142.6	11.8	Ie			
054615c RU TAURI—						
	4142.6	12.9	Ie			
054629 R COLUMBAE—						
	4105.3	[12.0	Sm	4111.3	[12.4	Sm
	4109.1	[13.0	Bl			
054920a U ORIONIS—						
	4092.0	7.6	Kk	4120.2	8.0	Ch
	4093.1	7.5	Kk	4137.7	9.0	Cy
	4095.0	7.8	Kk	4138.7	9.0	Mh
	4096.1	7.6	Kk	4140.7	8.6	Bi
	4101.1	7.4	Nk	4142.6	7.9	Hu
	4104.1	8.1	Kk	4144.6	9.0	Sg
	4106.0	7.9	Nk	4144.7	8.8	Pt
	4107.0	7.8	Nk	4150.7	9.0	Bi
	4108.0	7.9	Nk	4150.7	9.5	Lv
	4109.0	8.0	Nk	4152.1	9.1	B
	4109.0	8.4	Kk	4157.2	9.1	Bi
	4110.2	7.3	Ch	4160.1	9.5	Lv
	4112.0	8.0	Nk	4165.0	9.7	Gb
	4113.0	8.1	Nk	4166.1	10.4	Cy
	4113.1	8.6	Kk	4167.1	9.2	B
	4117.0	8.8	Kk			
054920b UW ORIONIS—						
	4134.6	10.4	Cy	4150.7	10.9	Bi
	4137.7	10.2	Cy	4150.7	10.4	Lv
	4140.7	10.4	Cy	4157.2	10.9	Bi
	4140.7	10.9	Bi	4160.1	10.8	Lv
	4142.6	10.4	Cy	4166.1	10.5	Cy
	4146.6	10.5	Cy			
054974 V CAMELOPARDALIS—						
	4144.6	13.3	B	4148.6	13.6	Ie
	4144.7	13.1	Pt	4161.0	[13.0	B
055353 Z AURIGAE—						
	4119.2	9.9	Ch	4161.1	9.8	B
	4138.6	9.8	B	4165.0	10.0	Pt
	4144.7	9.5	Pt			
055686 R OCTANTIS—						
	4091.3	11.0	Sm	4107.1	10.9	Bl
	4098.1	11.0	Bl	4113.3	10.3	Sm
	4107.3	10.6	Sm			
060450 X AURIGAE—						
	4112.1	8.8	Ch	4153.1	11.6	B
	4142.5	10.8	Ie	4167.2	11.8	Ie
060547 SS AURIGAE—						
	4075.6	[13.9	Wf	4142.6	12.6	Pt
	4077.6	[13.3	Wf	4142.6	13.6	Ie
	4085.6	[13.9	Wf	4142.6	12.6	Cy
	4099.2	11.6	Ch	4142.7	[12.4	Sg
	4100.2	[11.2	Ch	4143.6	13.6	B
	4101.2	[11.2	Ch	4143.7	13.8	Sg
	4102.2	[11.2	Ch	4144.6	14.0	B
	4103.2	11.0	Ch	4145.0	[13.3	Cd
	4107.0	14.9	Nk	4145.5	[12.6	Pt
	4108.0	14.9	Nk	4146.6	[13.3	Cy
	4109.0	15.1	Nk	4146.6	13.3	Ie
	4110.2	11.6	Ch	4146.6	[12.6	Pt
	4111.2	[11.6	Ch	4147.6	[12.6	Pt
	4112.1	[11.6	Ch	4147.6	[13.3	Du
	4113.2	[11.6	Ch	4148.6	[13.4	Du

VARIABLE STAR OBSERVATIONS RECEIVED DURING JANUARY, 1925—Continued.

Star	J.D.	Est.	Obs.	J.D.	Est.	Obs.
060547 SS AURIGAE—Continued.						
	4114.2	[11.6	Ch	4149.7	[12.4	Pt
	4119.2	11.6	Ch	4150.5	[12.4	Pt
	4119.6	14.9	Wf	4150.7	[13.0	Bi
	4120.2	[11.6	Ch	4154.2	[13.9	Wf
	4121.2	[11.6	Ch	4156.0	[12.4	Pt
	4122.2	[11.6	Ch	4156.1	[12.6	Ie
	4123.5	[11.6	Ch	4157.4	[11.5	Pt
	4124.4	[11.6	Ch	4158.0	[12.4	Pt
	4125.4	[11.6	Ch	4158.2	[13.9	Wf
	4126.2	[11.2	Ch	4160.0	[12.4	Pt
	4127.4	[12.4	Ch	4160.1	[11.6	Ie
	4134.6	10.5	Cy	4160.2	[12.0	Lv
	4137.6	11.1	B	4161.0	[11.0	Pt
	4137.7	11.4	Cy	4161.1	[11.6	Cy
	4138.6	11.3	B	4162.0	[11.0	Pt
	4139.6	11.8	B	4163.1	[12.4	Sg
	4139.9	11.7	Cy	4165.0	[12.4	Pt
	4140.2	11.1	L	4166.0	[13.3	Ie
	4140.5	12.1	Ie	4166.1	[12.4	Cy
	4140.5	11.9	Cy	4167.0	12.6	Ie
	4140.7	12.0	Cy	4167.2	13.0	Cy
	4141.2	12.1	L	4170.0	12.6	Ks
	4141.5	12.8	Ie			
061647 V AURIGAE—						
	4153.1	10.5	B			
061702 V MONOCEROTIS—						
	4113.2	11.8	Ch	4144.7	10.6	Pt
063159 U LYNCIS—						
	4138.7	14.0	B			
063308 R MONOCEROTIS—						
	4144.7	10.5	Pt	4152.2	11.6	B
063558 S LYNCIS—						
	4138.6	10.6	B	4161.1	8 8	B
	4144.7	10.0	Pt			
064030 X GEMINORUM—						
	4140.6	12.9	Ie	4166.1	11.0	Ie
	4144.6	12.7	B			
064707 W MONOCEROTIS—						
	4144 7	10.0	Pt	4153.1	9.5	B
065111 Y MONOCEROTIS—						
	4139.7	13.7	B	4150.7	13.5	Lv
	4140 7	12.8	Lv	4167.1	13.2	B
	4144.7	13.7	Pt			
065208 X MONOCEROTIS—						
	4095.3	7.7	Kk	4113.2	7.5	Ch
	4096.2	7.6	Kk			
065355 R LYNCIS—						
	4166.1	13.1	Ie			
070109 V CANIS MINORIS—						
	4125.5	[10 3	Ch	4153.1	12.4	B
	4140.6	11.8	Ie	4167.1	12.5	Ie
070122a R GEMINORUM—						
	4092.0	7.2	Kk	4144.7	7.0	Pt
	4092.9	7.2	Kk	4146.6	7.0	Al
	4095.0	7.1	Kk	4148.6	7.0	Ie
	4096.1	7.2	Kk	4149.6	7.7	Mz
	4107.9	7.1	Kk	4153.1	7.3	B
	4111.0	7.0	Kk	4158.0	8.1	Mz
	4140.7	7.3	Lv	4169.2	7.2	Al
	4142.6	6.9	Mz			

Star	J.D.	Est.	Obs.	J.D.	Est.	Obs.
070122b Z GEMINORUM—						
	4140.7	8.7	Lv	4148.6	12 3	Ie
	4144.7	12.4	Pt			
070122c TW GEMINORUM—						
	4144.7	7.9	Pt			
070310 R CANIS MINORIS—						
	4153.1	8.6	B			
070772 R VOLANTIS—						
	4091.3	10.6	Sm	4111.3	9.9	Sm
	4101.4	10.1	Ht	4113.4	10.2	Ht
	4105.3	10.1	Ht	4120.3	10.1	Ht
	4105.3	10.6	Sm			
071201 RR MONOCEROTIS—						
	4113.2	10.5	Ch	4150.7	11.1	B
071713 V GEMINORUM—						
	4143.7	[14.0	B	4146.6	[13.4	Ie
	4144 7	13.5	Pt	4165.1	[14.0	B
072708 S CANIS MINORIS—						
	4111.5	11.5	Ch	4146.6	9.4	Al
	4137.7	10.1	Cy	4153.1	9.1	B
	4142.7	8.7	Jo	4156.1	9.3	Ie
	4142.7	9.8	Sg	4166.2	8.7	Sg
	4144.7	9.5	Pt	4167.2	8 7	Cy
	4145.0	9.8	Cd	4169.2	8.8	Al
072811 T CANIS MINORIS—						
	4144.7	13.3	Pt	4155.1	13.8	B
	4146.6	[13.8	Ie			
073173 S VOLANTIS—						
	4098.1	10.9	Bl	4107.1	10.7	Bl
073508 U CANIS MINORIS—						
	4144.7	8.8	Pt	4153.1	8.8	B
073723 S GEMINORUM—						
	4144.6	13.7	B	4167.1	13.8	Ie
	4148.6	[12 7	Ie			
074241 W PUPPIS—						
	4098.1	10.4	Bl	4111.4	9.7	Sm
	4105.4	10.4	Sm	4113.4	9.4	Ht
	4105.4	10.6	Ht	4120.4	9.4	Ht
	4107.1	10.3	Bl			
074323 T GEMINORUM—						
	4127.4	[12.4	Ch	4143.7	[14.0	B
	4140 7	[13.1	Ie	4163.1	11.8	B
074922 U GEMINORUM—						
	4099.4	[10.9	Ch	4147.6	13.6	Du
	4100.2	[10.1	Ch	4147.7	[13.3	Ie
	4101.2	[10.1	Ch	4148.6	[13.3	Ie
	4102.2	[10.1	Ch	4148.6	13.7	Du
	4103.2	[10.1	Ch	4149.7	[12.4	Pt
	4110.2	[12.3	Ch	4151.0	8.9	Ie
	4111.2	[12 3	Ch	4152.2	8.8	Du
	4112.2	[12.4	Ch	4152.2	9.4	B
	4113.2	[13.3	Ch	4153.1	9.6	B
	4114.2	[12.3	Ch	4154.0	9.6	B
	4119.2	[12.3	Ch	4154.2	9.1	Wf
	4120.2	[12.3	Ch	4155.0	8.9	Cd
	4121.2	[12.3	Ch	4155.1	9.4	B
	4122.2	[12.3	Ch	4156.1	9.0	Ie
	4123.5	[12.4	Ch	4156.2	9 3	Wf
	4124.4	[12.4	Ch	4156.4	9.2	Cy
	4125.4	[12.4	Ch	4157.4	9.3	Pt
	4126.2	[10.9	Ch	4158.0	9.1	Pt

VARIABLE STAR OBSERVATIONS RECEIVED DURING JANUARY, 1925—Continued.

Star	J.D.	Est.	Obs.	J.D.	Est.	Obs.
074922 U GEMINORUM—Continued.						
	4134.6	[10.9	Cy	4158.1	9.5	Ie
	4137.7	13.6	B	4158.2	9.0	Cy
	4137.7	[13.3	Cy	4159.1	9.6	Ie
	4138.7	13.9	B	4159.1	9.9	B
	4139.7	14.0	B	4160.0	9.7	Ie
	4139.9	[13.3	Cy	4160.1	9.5	Pt
	4140.6	[12.5	Du	4160.3	9.6	Cy
	4140.6	[13.3	Ie	4161.1	10.0	B
	4141.6	[13.3	Ie	4162.0	9.9	Cd
	4142.6	[12.4	Pt	4165.0	10.5	Pt
	4142.6	[12.4	Cy	4165.1	11.4	B
	4143.7	13.6	B	4166.0	11.2	Pt
	4144.7	13.8	B	4166.0	11.1	Ie
	4144.7	[13.3	Pt	4166.1	11.5	Cy
	4146.0	[13.7	Cd	4167.1	12.8	B
	4146.6	[13.3	Ie	4167.1	11.7	Pt
	4146.6	[13.3	Cy	4167.2	12.4	Cy
	4146.6	[13.3	Pt	4168.0	13.4	Ie
	4146.6	13.6	Du	4170.1	[12.6	Ks
	4147.6	[13.3	Pt	4170.2	[13.3	Pt
075612 U PUPPIS—						
	4127.4	[10.8	Ch			
081112 R CANCRI—						
	4119.2	11.5	Ch	4144.7	10.7	Pt
	4140.8	10.0	Cy	4166.1	10.2	Ie
081617 V CANCRI—						
	4119.2	9.1	Ch	4144.7	8.4	Pt
	4140.8	8.8	Cy	4167.1	8.4	B
082405 RT HYDRAE—						
	4144.7	7.5	Pt			
082476 R CHAMAELONTIS—						
	4109.1	[12.6	Bl			
083019 U CANCRI—						
	4140.8	11.4	Cy	4166.1	10.2	Ie
	4165.1	10.2	B			
084803 S HYDRAE—						
	4125.5	9.7	Ch	4146.7	8.3	Cy
	4144.7	8.4	Pt			
085008 T HYDRAE—						
	4125.5	9.7	Ch	4144.7	10 8	Pt
085120 T CANCRI—						
	4140.8	9.0	Cy	4144.7	8.1	Pt
090151 V URSAE MAJORIS—						
	4106.6	10.0	Nk	4111.1	10.4	Nk
	4107.0	10.2	Nk	4113.1	10.4	Nk
	4108.1	10.4	Nk			
090425 W CANCRI—						
	4140.8	[12.6	Cy			
091868 RW CARINAE—						
	4109.1	[13.0	Bl			
092551 Y VELORUM—						
	4107.4	[11.3	Sm	4109.1	[12.9	Bl
092962 R CARINAE—						
	4098.1	4.3	Bl	4107.4	4 6	Sm
	4107.1	4.1	Bl	4113.4	4.6	Sm
093014 X HYDRAE—						
	4119.5	[11.0	Ch	4157.4	12.8	Pt
093178 Y DRACONIS—						
	4127.5	[10.8	Ch	4167.1	[13.4	Ie
	4140.8	[13.4	Cy			
093934 R LEONIS MINORIS—						
	4119.2	[10.5	Ch	4157.4	11.7	Pt
	4146.8	11.8	Cy			
094211 R LEONIS—						
	4099.4	10.3	Ch	4157.9	9.5	Pt
	4106.4	8.7	Nk	4158.9	9.6	Cy
	4113 3	9.1	Nk	4166.2	10.4	Sg
	4139.9	10.0	Cy	4169.0	9 8	Mh
	4157.1	10.0	Mz	4169.2	9.3	Al
094622 Y HYDRAE—						
	4157.4	6.6	Pt			
094953 Z VELORUM—						
	4098.1	11.0	Bl	4113.4	10.1	Ht
	4107.1	10.3	Bl	4120.4	9.4	Ht
095421 V LEONIS—						
	4146.8	9.3	Cy	4158.4	9.9	Cy
	4157.4	10.0	Pt	4167.2	10.7	Cy
095563 RV CARINAE—						
	4109.1	[13.1	Bl			
100661 S CARINAE—						
	4098.1	9.1	Bl	4113.4	8.0	Sm
	4107.1	8.1	Bl	4113.4	8.0	Ht
	4107.4	8.6	Sm	4120.4	7.7	Ht
101058 Z CARINAE—						
	4098.1	11.5	Bl	4107.1	11.6	Bl
101153 W VELORUM—						
	4098.1	8.8	Bl	4107.1	9.1	Bl
103212 U HYDRAE—						
	4088.3	5.9	Kd	4113.3	5.6	Kk
	4092.1	5.7	Kk	4114.3	6.1	Kd
	4093.1	5.5	Kk	4116.3	6.0	Kd
	4095.2	5.4	Kk	4117.3	5.5	Kk
	4096.2	5.5	Kk	4120.3	6.1	Kd
	4097.3	6.0	Kd	4132.3	6.1	Kd
	4099.3	6.0	Kd			
103769 R URSAE MAJORIS—						
	4075.6	11.8	Wf	4148.6	7.4	Mh
	4112.5	10.7	Ch	4151.0	6.9	Cd
	4123.4	10.0	Ch	4151.4	6.3	Pt
	4138.7	8.0	Mh	4160.3	6.7	Cy
	4140.8	7.0	Cy	4163.0	6.6	Ly
	4142.6	7.0	Ie	4166.2	6.6	Sg
	4142.7	6.8	Sg	4169.0	6.6	Ly
	4146.5	7.1	Du	4169.1	8.0	Mh
	4146.6	6.6	Ly	4169.2	7.8	Al
	4148.5	6.5	Cy			
104620 V HYDRAE—						
	4119.5	11.7	Ch	4157.4	11.3	Pt
	4124.4	11.7	Ch			
104814 W LEONIS—						
	4146.8	[12.7	Cy			
110506 S LEONIS—						
	4146.8	[12.9	Cy			
111561 RY CARINAE—						
	4098.1	12.5	Bl			
111661 RS CENTAURI—						
	4098.1	10.6	Bl	4107.1	11.8	Bl
115058 W CENTAURI—						
	4098.1	10.2	Bl			
115919 R COMAE—						
	4123.5	[10.9	Ch			

VARIABLE STAR OBSERVATIONS RECEIVED DURING JANUARY, 1925—Continued.

Star	J.D.	Est.	Obs.	J.D.	Est.	Obs.
120012 SU VIRGINIS—						
	4123.4	11.4	Ch	4157.4	10.9	Pt
121418 R CORVI—						
	4113.	7.7	Kk	4157.4	9.9	Pt
	4117.3	7.6	Kk			
122001 SS VIRGINIS—						
	4088.3	6.9	Kd	4116.3	6.9	Kd
	4099.3	6.8	Kd	4120.3	7.3	Kd
	4105.3	6.8	Kd	4132.3	7.4	Kd
	4108.3	6.7	Kd	4142.3	7.5	Kd
122532 T CANUM VENATICORUM—						
	4157.4	9.5	Pt			
122854 U CENTAURI—						
	4098.1	7.2	Bl			
123160 T URSAE MAJORIS—						
	4075.6	8.4	Wf	4133.0	9.3	Kl
	4092.1	8.6	Kk	4139.9	9.9	Cy
	4093.1	8.7	Kk	4148.6	10.1	Ie
	4095.2	8.7	Kk	4148.6	10.4	Du
	4096.2	8.7	Kk	4166.1	11.9	Pt
	4113.1	9.0	Kk	4166.2	[10.8	Sg
	4117.2	9.1	Kk	4167.1	11.7	Ie
	4127.0	9.3	Kl			
123307 R VIRGINIS—						
	4157.4	10.7	Pt			
123459 RS URSAE MAJORIS—						
	4112.5	[11.0	Ch	4166.2	[11.1	Sg
	4148 6	[13.2	Du	4167.0	[11.3	Cy
	4166.1	13.4	Pt	4167.1	[12.6	Ie
123961 S URSAE MAJORIS—						
	4075.6	8.9	Wf	4148.6	11.2	Du
	4127.0	10.3	Kl	4166.1	11.3	Pt
	4133.0	10.6	Kl	4166.2	[11 1	Sg
	4139.9	11.1	Cy			
124204 RU VIRGINIS—						
	4158.4	13.3	Pt			
124606 U VIRGINIS—						
	4157.4	10.5	Pt			
131283 U OCTANTIS—						
	4091.3	10.8	Sm	4107.1	11.0	Bl
	4097.9	10.7	Bl	4111.4	[11.2	Sm
	4105.4	11.7	Sm			
132422 R HYDRAE—						
	4116.1	[8.0	Kd	4158.4	8.4	Pt
	4120.3	[8.5	Kd			
132706 S VIRGINIS—						
	4158.4	11.6	Pt	4158.5	11.8	Cy
133155 RV CENTAURI—						
	4097.9	7.2	Bl			
133273 T URSAE MINORIS—						
	4077.6	14.5	Wf			
135908 RR VIRGINIS—						
	4158.4	12.7	Pt			
133633 T CENTAURI—						
	4120.3	6.4	Kd	4138.3	6.1	Kd
	4132.3	6.0	Kd	4142.3	6.1	Kd
134440 R CANUM VENATICORUM—						
	4057.4	8.3	Pt			
134677 T APODIS—						
	4091.3	10.6	Sm	4107.3	9.0	Sm
	4097.9	9.6	Bl	4113.3	9.0	Sm
	4107.1	9.7	Bl			
140959 R CENTAURI—						
	4097.9	6.7	Bl	4108.9	6.8	Bl
141567 U URSAE MINORIS—						
	4119.5	9.4	Ch	4157.4	8.0	Pt
141954 S BOOTIS—						
	4075.6	8.6	Wf	4157.4	11.8	Pt
142539 V BOOTIS—						
	4139.9	8.2	Cy	4158.5	7.8	Cy
	4157.4	8.2	Pt			
142584 R CAMELOPARDALIS—						
	4075.6	9.2	Wf	4141.5	12.3	Ie
143227 R BOOTIS—						
	4157.4	8.1	Pt	4160.4	7.7	Ie
144918 U BOOTIS—						
	4146.9	10.4	Cy			
145971 S APODIS—						
	4091.3	10.0	Sm	4108.9	10.8	Bl
	4097.9	11.2	Bl	4113.3	10.0	Sm
	4107.3	10.0	Sm			
150018 RT LIBRAE—						
	4158.4	10.8	Pt			
150605 Y LIBRAE—						
	4158.4	9.3	Pt			
151714 S SERPENTIS—						
	4077.6	10.0	Wf	4158.4	9.2	Pt
151731 S CORONAE BOREALIS—						
	4075.6	12.2	Wf	4127.5	6.6	Ch
	4119.5	6.9	Ch	4158.4	7.2	Pt
152714 RU LIBRAE—						
	4157.4	9.4	Pt			
153378 S URSAE MINORIS—						
	4075.6	12.2	Wf	4111.0	10.5	Nk
	4106.0	10.5	Nk	4112.0	10.6	Nk
	4107.0	10.5	Nk	4113.0	10.4	Nk
	4108.0	10.5	Nk	4137.6	10.2	Sg
	4109.0	10.4	Nk			
154428 R CORONAE BOREALIS—						
	4075.6	8.2	Wf	4109.8	6.0	Kk
	4077.6	8.2	Wf	4112.5	6.4	Ch
	4084.9	7.1	Kd	4116.3	6.4	Kd
	4085.6	7.5	Wf	4119.6	6.6	Wf
	4087.9	7.0	Kd	4120.3	6.5	Kd
	4091.2	6.9	Kk	4123.5	6.4	Ch
	4091.9	6.5	Kd	4124.3	6.3	Kd
	4092.8	6.9	Kk	4131.4	6.4	Kd
	4094.8	6.8	Kk	4132.3	6.2	Kd
	4096.8	6.9	Kk	4138.3	6.3	Kd
	4097.8	6.6	Kk	4139.9	6.3	Cy
	4099.8	6.5	Kk	4140.8	6.3	Cy
	4101.8	6.4	Kk	4142.3	6.4	Kd
	4102.8	6.3	Kk	4146.9	6.4	Cy
	4104.0	6.6	Ch	4156.4	6.3	Cy
	4104.8	6.0	Kk	4157.4	6.2	Pt
	4106.8	6.1	Kk	4158.4	6.2	Pt
	4106.9	6.4	Kd	4158.4	6.3	Cy
	4108.3	6.4	Kd	4160.4	6.0	Ie

VARIABLE STAR OBSERVATIONS RECEIVED DURING JANUARY, 1925—Continued.

Star	J.D.	Est.	Obs.	J.D.	Est.	Obs.
154536 X CORONAE BOREALIS—						
	4075.6	12.5	Wf			
154615 R SERPENTIS—						
	4125.5	[10.3	Ch	4158.4	8.1	Pt
154638 V CORONAE BOREALIS—						
	4075.6	7.5	Wf	4158.4	7.9	Pt
155018 RR LIBRAE—						
	4158.4	11.5	Pt			
155823 RZ SCORPII—						
	4158.4	10.7	Pt			
160118 R HERCULIS—						
	4158.4	9.5	Pt			
160325 SX HERCULIS—						
	4157.4	7.9	Pt	4158.4	7.9	Pt
160625 RU HERCULIS—						
	4075.6	12.0	Wf			
161122b S SCORPII—						
	4158.4	12.8	Pt	4158.4	13.0	Pt
161138 W CORONAE BOREALIS—						
	4076.6	12.8	Wf	4158.4	8.6	Pt
161607 W OPHIUCHI—						
	4158.4	10.7	Pt			
162112 V OPHIUCHI—						
	4158.4	8.0	Pt			
162119 U HERCULIS—						
	4075.6	11.2	Wf	4158.4	13.1	Pt
	4104.0	[11.3	Ch			
162807 SS HERCULIS—						
	4058.4	10.0	Pt			
163137 W HERCULIS—						
	4104.0	11.4	Ch	4158.4	13.6	Pt
163266 R DRACONIS—						
	4104.1	7.7	Ch	4165.0	8.3	Pt
	4112.0	7.5	Ch			
164715 S HERCULIS—						
	4158.4	12.6	Pt			
164844 RS SCORPII—						
	4097.9	11.2	Bl	4108.9	10.8	Bl
165202 SS OPHIUCHI—						
	4158.4	8.1	Pt			
165631 RV HERCULIS—						
	4158.4	14.7	Pt			
165636 RT SCORPII—						
	4097.9	11.0	Bl	4108.9	11.1	Bl
170627 RT HERCULIS—						
	4077.6	14.3	Wf			
171401 Z OPHIUCHI—						
	4158.4	8.4	Pt			
171723 RS HERCULIS—						
	4075.6	7.8	Wf	4108.9	8.7	Nk
	4105.9	8.7	Nk	4111.9	9.0	Nk
	4106.9	8.9	Nk	4158.4	11.6	Pt
	4107.9	8.7	Nk			
172486 S OCTANTIS—						
	4105.3	12.4	Ht	4113.4	12.0	Ht
	4109.0	12.0	Bl	4120.3	11.1	Ht
172809 RU OPHIUCHI—						
	4158.4	13.3	Pt			
173543 RU SCORPII—						
	4097.9	8.9	Bl	4108.9	9.1	Bl
174162 W PAVONIS—						
	4101.3	[11.0	Ht	4109.0	[13.0	Bl
	4105.3	[12.1	Ht			
174551 U ARAE—						
	4091.3	8.5	Sm	4111.3	9.8	Sm
	4105.3	9.4	Sm			
175519 RY HERCULIS—						
	4112.0	[11.0	Ch	4158.4	9.2	Pt
175654 V DRACONIS—						
	4146.5	9.8	Ie	4146.5	9.8	Pt
180363 R PAVONIS—						
	4091.3	8.5	Sm	4105.3	9.4	Sm
	4101.3	9.5	Ht	4111.3	9.8	Sm
	4105.3	9.8	Ht			
180531 T HERCULIS—						
	4106.0	[11.0	Nk	4140.2	11.5	L
	4112.0	[11.0	Ch	4146.5	11.2	Pt
180666 X DRACONIS—						
	4146.5	12.5	Pt			
181136 W LYRAE—						
	4075.6	9.2	Wf	4112.0	10.2	Nk
	4093.0	9.7	Nk	4112.9	10.1	Nk
	4106.0	9.9	Nk	4140.3	11.0	L
	4108.0	10.6	Nk	4140.5	[10.5	Mz
	4109.0	9.5	Nk	4146.5	11.1	Pt
	4111.0	9.8	Nk			
182133 RV SAGITTARII—						
	4097.9	12.3	Bl	4108.9	12.2	Bl
182224 SV HERCULIS—						
	4140.3	10.8	L			
183308 X OPHIUCHI—						
	4106.0	7.2	Nk	4107.9	7.2	Nk
	4106.9	7.3	Nk	4111.9	7.2	Nk
184134 RY LYRAE—						
	4146.5	11.2	Pt	4151.0	11.1	Cd
	4148.5	11.4	Ie			
184205 R SCUTI—						
	4087.9	5.4	Kd	4109.8	5.8	Kk
	4091.8	5.6	Kk	4111.0	5.9	Ch
	4091.9	5.5	Kd	4111.9	5.8	Kd
	4092.8	5.7	Kk	4111.9	5.7	Kk
	4094.8	5.7	Kk	4113.8	5.8	Kk
	4096.9	5.7	Kk	4115.9	5.7	Kd
	4097.8	5.7	Kk	4115.9	5.9	Kk
	4097.8	5.8	Kk	4116.8	5.9	Kk
	4099.8	5.7	Kk	4118.8	6.0	Kk
	4099.9	5.8	Kk	4118.9	5.7	Kk
	4101.8	5.6	Kk	4123.9	5.9	Kd
	4102.8	5.6	Kk	4127.9	5.7	Kd
	4104.8	5.7	Kk	4131.9	5.8	Kd
	4106.8	5.7	Kk	4132.9	5.9	Kd
	4106.9	5.8	Kd	4134.5	5.5	Cy
	4107.9	5.9	Kd	4140.2	5.8	L
184300 NOVA AQUILAE—						
	4093.0	10.2	Nk	4108.9	10.4	Nk
	4100.0	10.2	Nk	4111.0	10.3	Ch
	4106.9	10.4	Nk	4111.9	10.4	Nk
	4107.9	10.3	Nk			
185032 RX LYRAE—						
	4114.1	[12.5	Ch	4140.5	[12.5	Mz

VARIABLE STAR OBSERVATIONS RECEIVED DURING JANUARY, 1925—Continued.

Star	J.D.	Est.	Obs.	J.D.	Est.	Obs.
185437a S CORONAE AUSTRALIS—						
	4097.9	12.0	Bl	4108.9	11.9	Bl
185537a R CORONAE AUSTRALIS—						
	4109.0	[12.5	Bl			
185537b T CORONAE AUSTRALIS—						
	4109.0	[12.5	Bl			
185737 RT LYRAE—						
	4114.1	[12.0	Ch			
190818 RX SAGITTARII—						
	4111.0	9.6	Ch			
190925 S LYRAE—						
	4114.1	[11.0	Ch	4146.5	13.3	Pt
190926 X LYRAE—						
	4146.5	9.0	Pt			
190933a RS LYRAE—						
	4113.1	[11.2	Ch			
190941 RU LYRAE—						
	4146.5	11.3	Pt			
190967a U DRACONIS—						
	4119.1	11.6	Ch	4146.5	13.1	Pt
	4146.5	13.1	Ie			
191017 T SAGITTARII—						
	4111.0	[11.8	Ch			
191019 R SAGITTARII—						
	4111.0	10.0	Ch			
191033 RY SAGITTARII—						
	4091.3	7.5	Sm	4111.0	7.7	Ch
	4097.9	7.6	Bl	4111.3	7.5	Sm
	4105.3	7.7	Sm	4116.3	7.5	Sm
	4107.0	7.7	Bl			
191124 TY SAGITTARII—						
	4097.9	9.9	Bl	4109.0	9.3	Bl
191319 S SAGITTARII—						
	4097.9	9.9	Bl			
191331 SW SAGITTARII—						
	4109.0	12.4	Bl			
191350 TZ CYGNI—						
	4146.5	10.6	Pt			
191637 U LYRAE—						
	4146.5	10.2	Pt			
192745 AF CYGNI—						
	4091.9	7.3	Kk	4104.9	7.2	Kk
	4092.9	7.6	Kk	4109.9	7.1	Kk
	4094.9	7.5	Kk	4112.2	7.0	Kk
	4096.1	7.4	Kk	4116.8	6.9	Kk
192928 TY CYGNI—						
	4114.1	11.0	Ch	4146.5	12.2	Pt
193311 RT AQUARII—						
	4114.1	[11.0	Ch	4142.5	13.7	Pt
	4140.5	13.0	Ie			
193449 R CYGNI—						
	4075.6	8.8	Wf	4140.5	10.1	Bi
	4095 1	8.1	Nk	4142.5	9.6	Pt
	4103.1	9.4	Ch	4145.6	9.9	Sg
	4106.6	9.1	Nk	4148.5	10.8	Ly
	4107.0	9.1	Nk	4149.5	10.8	Mz
	4108.0	9.1	Nk	4154.0	10.5	Bi
	4108.9	9.3	Nk	4158.4	10.9	Lv
	4111.0	9.4	Nk	4160.0	11.0	Bi
193449 R CYGNI—Continued.						
	4111.1	9.9	Ch	4162.1	[10.9	Sg
	4112.0	9.4	Nk	4163.0	11.0	Bi
	4112.9	9.6	Nk	4165.0	11.6	Bi
	4134.5	10.1	Cy	4166.0	11.2	Mz
	4140.5	10.4	Mz	4166.0	11.0	Ie
193509 RV AQUARII—						
	4140.5	[12.2	Ie	4142.5	12.7	Pt
193972 T PAVONIS—						
	4091.3	10.0	Sm	4107.0	11.6	Bl
	4097.9	11.2	Bl	4111.3	11.7	Sm
	4101.3	11.2	Ht	4113.3	12.1	Ht
	4105.3	11.3	Sm	4120.3	12.5	Ht
	4105.3	11.5	Ht			
194048 RT CYGNI—						
	4103.1	9.4	Ch	4151.0	11.6	Cd
	4111.1	10.8	Ch	4154.0	11.5	Bi
	4134.5	11.5	Cy	4160.0	11.6	Bi
	4140.0	11.5	Bi	4162.1	[10.8	Mz
	4140.5	11.2	Mz	4165.0	10.2	Cd
	4142.5	11.6	Pt	4166.0	11.2	Mz
	4145.6	[10.8	Sg			
194348 TU CYGNI—						
	4103.1	11.9	Ch	4142.5	9.3	Pt
	4111.1	10.0	Ch	4166.0	10.9	Mz
194604 X AQUARII—						
	4077.6	13.5	Wf	4142.5	9.3	Pt
	4140.5	9.8	Ie	4158.0	8.9	Mz
	4140.5	10.0	Mz			
194632 χ CYGNI—						
	4075.6	7.6	Wf	4114.0	6.1	Kd
	4091.9	8 8	Kk	4115.9	6.1	Kd
	4093.0	8.9	Nk	4116.8	6.1	Kk
	4094.9	8.8	Kk	4117.9	6.9	Kd
	4095.0	8.6	Nk	4118.8	6.2	Kk
	4095.2	8.7	Ch	4118.9	5.9	Kd
	4100.1	7.6	Ch	4120.1	6.5	Ch
	4101.0	7.4	Nk	4121.0	6.0	Kd
	4102.1	7.3	Ch	4121.9	6.0	Kd
	4104.8	7.4	Kk	4122.9	6.1	Kd
	4105.0	7.1	Nk	4123.9	6.0	Kd
	4106.0	6.9	Kd	4125.0	6.4	Ch
	4106.0	7.0	Nk	4127.9	5.9	Kd
	4106.9	6.9	Kd	4129.0	6.3	Ch
	4107.0	7.0	Nk	4130.9	5.9	Kd
	4108.0	6.7	Kd	4131.9	5.9	Kd
	4108.0	6 9	Nk	4132.9	6.1	Kd
	4108.9	6.5	Kd	4136.0	6.0	Kd
	4108.9	7.1	Nk	4137.0	5.9	Kd
	4111.0	6.3	Kd	4140.5	5.8	Mz
	4111.0	7.0	Nk	4140.9	5.9	Kd
	4111.8	6.2	Kk	4142.5	5.9	Pt
	4111.9	6.1	Kd	4143.9	5.9	Kd
	4112.0	7.0	Nk	4144.9	6.1	Kd
	4112.9	6.9	Nk	4158.0	6.5	Mz
	4113.1	6.6	Ch			
194929 RR SAGITTARII—						
	4097.9	6.8	Bl	4107.0	6.9	Bl

VARIABLE STAR OBSERVATIONS RECEIVED DURING JANUARY, 1925—Continued.

Star	J.D.	Est.	Obs.	J.D.	Est.	Obs.
195142 RU SAGITTARII—						
	4091.3	10.9	Sm	4107.0	9.3	Bl
	4097.9	10.3	Bl	4111.3	8.8	Sm
	4101.3	10.5	Ht	4113.3	8.8	Ht
	4105.3	9.7	Sm	4116.3	8.2	Sm
	4105.3	9.7	Ht	4120.3	7.6	Ht
195553 NOVA CYGNI—						
	4108.0	11.9	Nk	4144.5	12.2	Pt
	4109.6	11.9	Nk	4148.5	12.5	Ie
	4112.0	11.8	Nk	4150.5	12 2	Pt
	4113.0	11.9	Nk	4158.0	12.1	Pt
	4113.1	11.8	Ch	4165.0	12.2	Pt
	4141.5	12.2	Pt			
195849 Z CYGNI—						
	4075.6	12.5	Wf	4112.9	12.3	Nk
	4106.0	12.4	Nk	4113.1	[11.6	Ch
	4107.0	12.4	Nk	4140.6	[11.6	Mz
	4108.0	12.4	Nk	4142.5	12.6	Pt
	4109.0	12.3	Nk	4148.5	[12.7	Ie
	4112.0	12.3	Nk	4166.0	[11.6	Mz
195855 S TELESCOPII—						
	4109.0	13.1	Bl			
200212 SY AQUILAE—						
	4142.5	12.2	Pt	4150.5	12.1	L
200357 S CYGNI—						
	4075.7	11.3	Wf	4158.5	12.9	Lv
	4100.1	10.2	Ch	4160.0	13.1	Bi
	4139.5	12.5	Lv	4163.2	[11.7	Sg
	4142.5	12.0	Pt	4166.0	13.0	Ie
	4154.0	12.7	Bi			
200715a S AQUILAE—						
	4075.7	9.2	Wf	4142.5	10.1	Pt
	4114.1	10.0	Ch			
200715b RW AQUILAE—						
	4142.5	8.8	Pt			
200747 R TELESCOPII—						
	4109.0	12.7	Bl			
200822 W CAPRICORNI—						
	4097.9	11.6	Bl	4107.0	11.5	Bl
200906 Z AQUILAE—						
	4141.5	[12.6	Ie	4142.5	13.4	Pt
200938 RS CYGNI—						
	4101.2	7.8	Ch	4142.5	7.1	Pt
	4111.1	7.4	Ch	4146.5	7.5	Ly
	4113.1	7.3	Ch	4150.2	7.1	L
	4123.1	7.4	Ch	4160.0	7.2	Cy
	4134.5	7.3	Cy	4163.0	7.6	Ly
	4136.5	7.3	Cy	4163.1	6.9	Sg
	4140.3	7.1	L	4166.0	7.2	Cy
201008 R DELPHINI—						
	4142.5	11.0	Pt	4150.2	11.6	L
201121 RT CAPRICORNI—						
	4091.9	7.6	Kd	4111.9	7.6	Kd
	4107.9	7.6	Kd			
201130 SX CYGNI—						
	4134.5	[12.9	Cy	4148.5	[13.3	Ie
	4142.5	13.7	Pt			
201139 RT SAGITTARII—						
	4097.9	8.1	Bl	4107.0	8.6	Bl

Star	J.D.	Est.	Obs.	J.D.	Est.	Obs.
201437b WX CYGNI—						
	4111.1	10.5	Ch	4148.5	11.0	Cy
	4134.5	10.8	Cy	4154.0	10.1	Bi
	4140.5	10.8	Cy	4160.0	11.1	Cy
	4140.5	9.6	Bi	4160.0	10.6	Ie
	4142.5	10.7	Pt	4163.1	[11.3	Sg
	4146.5	11.0	Cy	4166.0	11.6	Mz
	4146.5	10.7	Ly			
201647 U CYGNI—						
	4095.1	7.7	Nk	4142.5	7.6	Pt
	4101.0	7.7	Nk	4146.6	8.8	Jo
	4105.0	7.7	Nk	4148.6	[8.4	Mh
	4106.0	7.7	Nk	4149.5	8.9	Mz
	4107.0	7.8	Nk	4152.0	8.0	B
	4108.0	7.8	Nk	4154.0	8.3	Bi
	4109.0	7.9	Nk	4158.0	9.0	Mz
	4111.0	7.9	Nk	4158.0	[8.0	Mh
	4112.0	7.9	Nk	4161.0	8.5	Bi
	4112.9	7.9	Nk	4162.1	7.8	Sg
	4140.6	[7.8	Nk	4166.0	9.4	Mz
	4140.6	8.8	Mz	4167.0	8.2	B
	4140.5	8.3	Bi			
202240 U MICROSCOPII—						
	4097.9	8.9	Bl	4107.0	8.7	Bl
202817 Z DELPHINI—						
	4139.5	12.1	B	4142.5	12.4	Pt
201946 SZ CYGNI—						
	4141.5	9.9	Pt	4150.5	8.8	B
	4142.6	9.8	Pt	4158.0	9.7	Pt
	4144.5	9.4	Pt	4160.0	9.3	Pt
	4145.5	9.5	Pt	4161.0	9.3	Pt
	4146.6	9.2	Pt	4162.0	9.1	Pt
	4147.6	8.9	Pt	4165.0	9.0	Pt
	4150.5	8.8	Pt	4166.0	8.9	Pt
	4156.0	8.9	Pt			
202954 ST CYGNI—						
	4140.6	10.8	Bi	4154.0	10.5	Bi
	4142.5	10.7	Pt	4161.0	10.9	Bi
	4147.6	11.0	Ie			
203429 R MICROSCOPII—						
	4098.0	12.3	Bl	4109.0	[13.0	Bl
203611 Y DELPHINI—						
	4138.5	13.0	B			
203816 S DELPHINI—						
	4139.5	10.3	B	4142.5	9.8	Pt
203847 V CYGNI—						
	4075.7	10.2	Wf	4142.5	11.9	Pt
	4109.2	9.9	Ch	4150.5	7.6	B
	4111.1	9.8	Ch	4154.0	7.7	Bi
	4123.1	9.5	Ch	4154.0	8.1	Lv
	4140.6	8.3	Bi			
203905 Y AQUARII—						
	4134.5	[12.6	Hy			
204016 T DELPHINI—						
	4075.7	10.5	Wf	4112.0	11.5	Nk
	4093.0	11.2	Nk	4113.0	11.6	Nk
	4095.1	11 0	Nk	4134 5	13.0	Hy
	4106.0	11.4	Nk	4138.5	[13.0	B
	4107.0	11.4	Nk	4142.5	13.0	Pt
	4108.0	11.5	Nk	4146.5	[12.0	Hy
	4109.0	11.5	Nk	4148.5	[12.8	Ie

VARIABLE STAR OBSERVATIONS RECEIVED DURING JANUARY, 1925—Continued.

Star	J.D.	Est.	Obs.	J.D.	Est.	Obs.
204102 V AQUARII—						
	4142.5	8.8	Pt			
204215 U CAPRICORNI—						
	4107.0	11.9	Bl			
204318 V DELPHINI—						
	4138.5	12.5	B	4143.7	[12.4	Sg
204405 T AQUARII—						
	4134.5	10.8	Hy			
204846 RZ CYGNI—						
	4075.7	10.9	Wf	4154.0	12.0	Bi
	4140.6	11.8	Bi	4154.0	11.8	B
	4142.5	11.9	Pt	4160.0	12.6	Bi
	4147.6	11.9	Ie	4165.0	12.1	Bi
204954 S INDI—						
	4109.0	[13.1	Bl			
205017 X DELPHINI—						
	4142.5	9.4	Pt	4160.0	10.4	Bi
	4152.0	10.3	B			
205923 R VULPECULAE—						
	4075.7	13.3	Wf	4142.5	9.0	Pt
	4141.5	9.0	Ie	4160.4	9.1	Bi
	4141.6	8.6	Hu			
210124 V CAPRICORNI—						
	4098.0	8.3	Bl	4107.0	8.5	Bl
210129 TW CYGNI—						
	4152.0	11.1	B	4160.0	11.3	Ie
210221 X CAPRICORNI—						
	4109.0	[12.7	Bl			
210382 X CEPHEI—						
	4159.0	[12.1	B			
210504 RS AQUARII—						
	4140.3	10.1	L	4140.5	10.1	Ie
210812 R EQUULEI—						
	4075.7	14.3	Wf	4166.0	10.0	Pt
	4134.5	12.3	Hy	4146.5	11.4	Hy
210868 T CEPHEI—						
	4106.0	9.7	Nk	4140.5	9.9	Hy
	4107.0	9.2	Nk	4140.6	10.3	Mz
	4108.0	9.8	Nk	4142.6	9.8	Sg
	4109.0	9.8	Nk	4142.6	9.8	Pt
	4111.0	9.9	Nk	4159.0	9.8	B
	4112.0	9.9	Nk	4163.2	9.8	Sg
	4113.0	9.8	Nk	4166.1	10.3	Mz
211614 X PEGASI—						
	4075.7	14.0	Wf	4142.6	10.0	Pt
	4141.5	10.1	Ie	4159.0	9.7	B
211615 T CAPRICORNI—						
	4107.0	11.6	Bl			
212030 S MICROSCOPII—						
	4105.3	[12.4	Sm	4111.3	[12.4	Sm
	4109.0	[13.4	Bl			
213814 Y CAPRICORNI—						
	4109.0	[13.4	Bl	4138.5	12.1	B
213244 W CYGNI—						
	4088.9	6.5	Kd	4112.0	6.6	Kd
	4091.9	6.5	Kd	4112.8	6.5	Kk
	4091.9	6.5	Kk	4115.9	6.6	Kd
	4092.9	6.5	Kk	4116.8	6.7	Kk
	4094.9	6.3	Kk	4121.6	6.8	Kd
	4096.1	6.5	Kk	4123.9	6.8	Kd
	4097.0	6.6	Kd	4127.9	6.8	Kd
213244 W CYGNI—Continued.						
	4104.9	6.4	Kk	4130.9	6.8	Kd
	4106.0	6.6	Kd	4137.0	6.8	Kd
	4108.0	6.6	Kd	4140.9	6.7	Kd
	4109.8	6.5	Kk			
213678 S CEPHEI—						
	4140.5	9.4	Hy	4148.5	8.0	Hy
	4141.6	8.5	Hu	4150.5	9.1	B
	4142.6	8.4	Pt			
213753 RU CYGNI—						
	4113.1	8.0	Ch	4142.6	7.5	Pt
	4140.5	8.0	Cy			
213843 SS CYGNI—						
	4075.6	11.5	Wf	4146.2	11.1	L
	4077.6	11.4	Wf	4146.5	11.6	Du
	4085.6	8.6	Wf	4146.5	9.7	Ly
	4095.2	[10.9	Ch	4146.5	11.5	Ie
	4099.2	[10.9	Ch	4146.5	11.8	Hy
	4101.0	12.0	Nk	4146.0	11.7	Pt
	4101.1	11.7	Ch	4147.5	11.6	Ie
	4102.1	11.8	Ch	4147.5	11.6	Du
	4103.2	11.8	Ch	4147.6	11.7	Pt
	4104.1	11.3	Ch	4148.5	11.6	Ie
	4105.0	11.7	Nk	4148.5	11.7	Hy
	4106.0	11.5	Nk	4148.6	11.6	Du
	4107.0	11.4	Nk	4149.7	11.7	Pt
	4108.0	11.4	Nk	4150.2	11.7	L
	4109.0	11.4	Nk	4150.5	11.7	Pt
	4110.0	11.4	Nk	4150.5	11.4	B
	4110.1	11.7	Ch	4152.0	11.2	B
	4111.1	11.7	Ch	4154.0	10.3	B
	4112.0	11.5	Nk	4154.0	10.3	Lv
	4112.1	11.6	Ch	4154.0	10.3	Bi
	4113.0	11.4	Nk	4154.2	10.2	Mz
	4113.1	11.6	Ch	4155.1	10.2	B
	4114.1	11.6	Ch	4156.0	10.2	Ie
	4119.6	10.2	Wf	4156.0	10.0	Pt
	4119.6	9.8	Ch	4156.1	9.4	Wf
	4120.1	9.5	Ch	4157.0	10.1	Ie
	4121.2	9.5	Ch	4157.0	9.8	B
	4122.1	9.4	Ch	4157.1	9.5	Mz
	4123.1	9.3	Ch	4158.0	9.7	Ie
	4124.1	8.9	Ch	4158.0	9.5	Lv
	4125.1	8.8	Ch	4158.0	9.5	Pt
	4126.2	8.8	Ch	4158.0	9.6	Mz
	4127.1	8.8	Ch	4159.0	9.5	Ie
	4128.1	9.1	Ch	4159.0	9.1	B
	4134.6	11.6	Hy	4160.0	9.1	Ie
	4137.6	11.7	B	4160.0	8.4	Bi
	4138.6	11.6	B	4160.0	8.9	B
	4138.6	11.8	Mz	4160.0	9.4	Pt
	4139.5	11.3	Lv	4160.0	9.3	Hy
	4139.5	11.6	B	4160.0	9.1	Mz
	4140.4	11.5	Ie	4161.0	8.9	B
	4140.5	11.6	B	4161.0	9.0	Pt
	4140.5	11.7	Du	4161.0	8.6	Ie
	4140.5	11.8	Hy	4162.0	8.8	Pt
	4140.6	11.6	Bi	4162.1	9.0	Sg
	4141.2	11.7	L	4163.0	9.4	Bi
	4141.4	11.5	Ie	4165.0	10.0	Bi
	4141.6	11.9	Hu	4165.0	10.1	B

VARIABLE STAR OBSERVATIONS RECEIVED DURING JANUARY, 1925—Continued.

Star	J.D.	Est.Obs.	J.D.	Est.Obs.
213843 SS CYGNI—Continued.				
	4141.6	11.6 Hy	4165.0	9.5 Pt
	4142.5	11.6 Ie	4166.0	10.2 Hy
	4142.6	11.7 Pt	4166.0	10.0 Pt
	4142.6	11.6 Hy	4166.0	9.9 Ie
	4144.5	11.8 Pt	4167.0	11.1 B
	4145.0	11.9 Cd	4167.0	10.5 Ie
	4145.5	11.8 Pt	4169.0	11.3 Ly
213937 RV CYGNI—				
	4141.6	7.2 Hu	4152.0	6.7 B
	4142.6	6.5 Pt		
214024 RR PEGASI—				
	4075.7	13.6 Wf	4145.5	10.6 Pt
	4140.6	10.7 Mz	4146.5	8.8 Hy
214247 R GRUIS—				
	4091.3	9.5 Sm	4107.0	10.3 Bl
	4098.0	9.6 Bl	4111.3	11.4 Sm
	4101.3	9.9 Ht	4113.3	11.4 Ht
	4105.3	9.9 Ht	4130.3	11.4 Ht
	4105.3	10.3 Sm		
215605 V PEGASI—				
	4138.6	[13.2 B	4146.5	[12.7 Hy
	4134.5	[12.7 Hy	4167.0	13.0 B
215934 RT PEGASI—				
	4121.2	[10.3 Ch	4154.0	[13.0 Bi
	4140.6	[12.5 Lv	4159.0	11.2 B
	4142.7	[11.3 Sg	4160.0	[13.0 Bi
	4145.5	11.3 Pt	4161.0	[13.0 Bi
220133a RY PEGASI—				
	4139.6	12.3 B	4165.0	12.6 B
	4145.5	12.3 Pt		
220133b RZ PEGASI—				
	4139.6	11.6 B	4165.0	10.7 B
	4145.5	11.5 Pt		
220412 T PEGASI—				
	4138.6	[13.5 B	4167.0	12.6 B
220613 Y PEGASI—				
	4139.6	[13.0 B	4167.0	12.9 B
	4158.0	[12.8 Lv		
220714 RS PEGASI—				
	4139.6	10.3 B	4163.0	11.2 Bi
	4145.5	10.3 Pt	4167.0	10.8 B
	4158.0	10.9 Lv		
221948 S GRUIS—				
	4093.3	11.4 Sm	4105.3	10.8 Sm
	4104.3	11.4 Ht	4111.3	10.3 Sm
	4105.3	11.1 Ht	4113.3	9.4 Ht
222129 RV PEGASI—				
	4138.6	11.6 B	4159.1	12.3 B
222439 S LACERTAE—				
	4120.2	9.2 Ch	4157.1	8.4 Mz
	4145.5	8.0 Pt	4160.1	8.3 Bi
	4146.5	8.1 Hy	4166.0	8.5 Mz
	4152.1	8.1 B	4167.0	8.1 B
	4156.1	7.9 Ie		
222867 R INDI—				
	4098.0	9.0 Bl	4107.0	10.3 Bl
223462 T TUCANAE—				
	4101.3	10.9 Ht	4111.3	10.2 Sm
	4102.3	10.6 Ht	4113.3	10.4 Ht
	4105.4	10.2 Sm	4120.3	10.2 Ht
223841 R LACERTAE—				
	4120.2	9.1 Ch	4158.1	10.1 Lv
	4145.5	9.5 Pt	4160.1	10.0 Bi
	4157.1	9.9 Mz	4166.1	10.6 Mz
225914 RW PEGASI—				
	4138.6	12.8 B	4166.0	12.8 Ie
	4165.1	12.8 B		
230110 R PEGASI—				
	4145.5	11.0 Pt	4165.0	12.3 Cd
	4146.0	12.4 Cd		
230759 V CASSIOPEIAE—				
	4139.5	10.9 B	4146.5	11.1 Du
	4140.5	11.4 Hy	4159.1	10.0 B
	4142.7	10.9 Sg	4166.1	10.3 Mz
	4146.6	11.0 Hy	4166.1	10.6 Hy
231425 W PEGASI—				
	4121.2	8.5 Ch	4154.1	9.0 Bi
	4146.5	9.2 Hy	4160.1	9.1 Bi
231508 S PEGASI—				
	4121.2	9.1 Ch	4146.6	8.5 Hy
	4133.0	8.7 Kl	4159.0	8.1 B
	4145.5	8.3 Pt		
232746 V PHOENICIS—				
	4101.3	10.0 Ht	4113.3	9.7 Sm
	4105.3	9.7 Ht	4113.3	9.9 Ht
	4105.4	10.0 Sm	4120.3	9.9 Ht
232848 Z ANDROMEDAE—				
	4145.5	9.5 Pt	4166.1	9.2 Mz
233335 ST ANDROMEDAE—				
	4120.2	11.8 Ch	4145.5	8.9 Pt
	4141.6	8.2 Hu	4152.1	9.0 B
	4142.7	9.0 Sg	4162.2	9.2 Sg
233815 R AQUARII—				
	4145.0	9.6 Cd	4146.5	9.1 Ly
	4145.5	9.6 Pt		
233956 Z CASSIOPEIAE—				
	4075.5	11.7 Wf	4148.5	[13.1 Hy
	4138.6	13.5 B	4150.5	13.3 Lv
	4139.6	13.4 Lv	4158.1	13.2 Lv
	4142.6	[13.1 Hy	4165.1	[13.4 B
	4147.6	13.3 Ie		
235053 RR CASSIOPEIAE—				
	4138.6	13.8 B	4165.1	[13.0 B
	4147.6	[13.0 Ie		
235209 V CETI—				
	4109.0	13.0 Bl	4141.3	13.0 L
235265 R TUCANAE—				
	4107.3	[12.6 Sm		
235350 R CASSIOPEIAE—				
	4139.6	11.2 B	4150.5	10.7 Lv
	4140.5	11.2 Hy	4158.1	10.4 Lv
	4146.5	10.7 Ly	4165.1	10.2 B
	4150.5	10.1 Bi	4169.1	9.9 Ly
235525 Z PEGASI—				
	4122.6	9.4 Hy	4160.1	8.6 Ie
	4141.6	8.7 Hy	4166.0	8.9 Hy
	4145.5	8.8 Pt		
235939 SV ANDROMEDAE—				
	4138.6	12.5 B	4158.1	12.1 Ie
	4139.6	12.5 Lv	4159.1	12.4 B
	4142.7	12.6 Ie	4165.0	12.0 Pt
	4150.6	12.4 Ie		

Total number of stars observed	345
Total number of observations	1975

The following observers have contributed to this report: Allen "Al"; Baldwin, "Bl"; Berman, "Bi"; Bouton, "B"; Chandler, "Cd"; Chandra, "Ch"; Cilley, "Cy"; Dunham, "Du"; Gaebler, "Gb"; Henry, "Hy"; Mrs. Holmes, "Ho"; Houghton, "Ht"; Hunter, "Hu"; Iedema, "Ie"; Jones, "Jo"; Kanda, "Kd"; Kasai, "Kk"; Kleis, "Ks"; Kohl, "Kh"; Lacchini, "L"; Leavenworth, "Lv"; Mrs. Lytle, "Ly"; Marshall, "Mh"; Mitchell, "Mz"; Mrs. Morris, "Ms"; Nakamura, "Nk"; Peltier, "Pt"; Skaggs, "Sg"; Smith, "Sm"; and Waterfield, "Wf".

LEON CAMPBELL, Recording Secretary.

COMET AND ASTEROID NOTES.

Wolf's Comet. — Careful search near the predicted place of this comet was made on the night of February 13, with the 16-inch telescope of Goodsell Observatory, but although the air was very clear no trace of the comet was found. It is therefore probably not visible with a 16-inch telescope.

New elements, computed by Dr. A. Kahrstedt from observations at Heidelberg 1924 Dec. 22, 25 and 1925 Jan. 13 are given in the Copenhagen Circular No. 58.

Epoch = 1925 Jan. 14.0 Gr. Civil T.

$M = 357°.981$ $\quad \phi = 21°.999$

$\omega = 185.839$ $\quad \mu = 477''.139$

$\Omega = 260.632$ 1925.0 $\quad \log a = 0.58091$

$i = 22.843$

New Elements of Baade's Asteroid 1924 TD.—In the *Lick Observatory Bulletin* No. 359, Dr. H. Thiele gives the following elements of Baade's Asteroid 1924 TD, corrected by means of Lick Observatory observations between October 27 and December 2. These elements represent an observation on January 4 within $+0^s.56$ in α and $+3''.9$ in δ. The computed magnitude on March 1 is 13.3. An ephemeris is given extending from February 1 to March 1.

ELEMENTS OF PLANET 1924 TD (BAADE).

Epoch = 1924 Oct. 27.5 Gr. M. T.

M =	6°	34′	18″.41	
ω =	130	37	10.29	
Ω =	216	25	57.01	1924.0
i =	26	09	26.25	
ϕ =	32	40	01.41	
μ =	813″.314			

GENERAL NOTES

Professor J. A. Parkhurst, for many years a member of the staff of astronomers at the Yerkes Observatory, died on Sunday night, March 1, at the age of 63. His passing will be mourned by astronomers in all parts of the world. He was well known for his work in the photometric measurement of the light of the stars.

Professor Solon I. Bailey, for nearly forty years a member of the staff of the Harvard College Observatory, retired on February 1, 1925, from the active professorship of Astronomy at the Observatory to that of Professor Emeritus. On February 3 his many astronomical friends, nearly half a hundred strong, tendered him a complimentary dinner, presided over by Mr. George R. Agassiz, chairman of the Observatory Visiting Committee. Professor Bailey, besides being responsible for the establishment of the Boyden Station at Arequipa, Peru, is particularly noted for his discovery and discussion of many hundreds of cluster variables. He has travelled extensively, investigating different localities for observatory sites, and for a number of years was responsible for the establishment and maintenance of a series of meteorological stations on the west coast of Peru, from sea level to an altitude of 19,200 feet, on El Misti. Professor Bailey expects to maintain an active interest in astronomy in spite of his retirement and his three score years and ten.

Hood College Observatory.— Hood College, an institution of learning for women at Frederick, Md., presided over by Dr. Joseph H. Apple, began its second semester with the establishment of its newly erected observatory, which contains, among other equipment, an excellent eight-inch Clark equatorial. The new observatory building, besides having a well apportioned and commodious dome, has splendid facilities for classroom work and special investigations, with plenty of opportunity for further expansion.

La Plata Catalogue C.—Publications of the Observatorio Astronomico de La Plata, tome VIII, contains a catalogue of 4412 stars between 62° and 66° of south declination, the positions of which have been determined principally by Hugo A. Martinez during the years 1919-1921. This is the third catalogue to be issued by the La Plata Observatory as parts of the general plan begun in 1919 to observe the zone from —52° to —82° of declination. The catalogue for the zone —66° to —72° is in preparation and the observations for the zone —72° to —82° are being carried on.

Summary of Sun Spot Observations at Mt. Holyoke College, 1924

		North of Equator		South of Equator		Av. No.	
Month	No. of Obs.	No. of Groups	Av. Lat.	No. of Groups	Av. Lat.	at one Obs.	New Groups
Jan.	18	0	.....	0	.....	0.00	0
Feb.	18	1	+30°	1	— 9°	0.39	2
Mar.	15	2	+26.0	0	.....	0.27	1
Apr.	11	1	+24.	1	—27.	0.55	2
May	17	3	+33.7	4	—23.2	1.35	7
June	8	2	+25.5	0	.....	1.12	1
Sept.	7	2	+11.0	1	—25.	1.71	3
Oct.	25	8	+22.7	1	—35.	2.08	9
Nov.	21	4	+23.5	0	.....	0.95	3
Dec.	9	4	+23.8	0	.....	1.00	4
Total	149	27		8			32

Average number of groups at one observation 0.96
Average latitude of groups north of equator +24°.1
Average latitude of groups south of equator —23°.8
Number of days without spots 65

ALICE H. FARNSWORTH.

John Payson Williston Observatory.

U. S. Naval Observatory Eclipse Observations, 1905, 1918, 1923.—Publications of the U. S. Naval Observatory, Second Series, Volume X, Part II, Appendix, gives a tardy account of the expeditions from the Naval Observatory to observe the total solar eclipses of August 30, 1905, and June 8, 1918. The volume gives full details of the expeditions and the results obtained and is illustrated with excellent reproductions of a number of photographs of the solar corona and of the flash spectrum obtained in Spain in 1905, and a single photograph of the corona of 1918 taken at Baker, Oregon, with a drawing of the inner corona, made by H. R. Morgan, showing details obtained from several photographs.

The reproductions of the photographs of the chromospheric spectrum, obtained by S. A. Mitchell at the eclipse of August 30, 1905, are especially notable.

At the end of the volume is given a brief report of the attempts to observe the eclipse of Sept. 10, 1923, from U. S. Navy airplanes. One observer, Lieutenant L. D. Webb, appears to have seen the solar corona from an altitude of 16,500 feet, above Point Dunne, California. He encountered fog and cloud at lower levels. Two other observers saw the corona through thin clouds.

Total Solar Eclipse, 24 January 1925, from the Navy Airship "Los Angeles". —The following, from an abstract of a paper presented to the American Astronomical Society, at the Washington meeting in December, 1924, by F. B. Littell, was received too late to be used in our January issue. The complete abstract will appear in order in the report of the meeting.

Eclipse observations from airplanes were proposed to the Naval Observatory by Prof. D. P. Todd in 1919, and again by Col. John Millis, U. S. A., retired, in 1923. Some attempts were made in 1923, but no valuable results were secured. The proposal to observe the eclipse of 1925 from a Navy dirigible was made to the Naval Observatory by Col. Millis. The advantage of the dirigible over the airplane for the purpose is the steadier and larger platform for apparatus and observers. The disadvantage is the inability to ascend so high if necessary to over-ride clouds.

The North American Almanac for 1925 has recently come to this office. This book, styled "the Aristocrat of Almanacs," has made its appearance for five years in succession, each time a bit more extended than before. The issue for 1925 contains the usual information found in almanacs, namely, the times of sunrise and sunset, and of moonrise and moonset for each day throughout the year for Chicago. Tables are furnished for finding this information for more than fifty other cities in the United States. Besides this a large number of astronomical and other facts are presented in a simple yet accurate manner. Charts of the sky showing the stars that are visible are given with the dates when they are to be used. There are papers on various topics by writers who are recognized authorities in their fields. It is fully illustrated with one hundred and thirty halftones. One notes with satisfaction the lack of any attempt to forecast the weather for the year, which cannot be done scientifically for so long a period. The almanac is published by The North American Almanac Co., 124 W. Illinois Street, Chicago.

O. L. Dustheimer, professor of Mathematics and Astronomy, Baldwin-Wallace College, Berea, Ohio, gave five lectures on the Solar Eclipse of January 24, 1925, in Berea and Cleveland. On January 21 his talk was broadcast by the Cleveland Radio Station WTAM.

SHORT ECLIPSE NOTES.

At the Yerkes Observatory.

The sky was totally cloudy here so that there was no opportunity for us to use any instrument.

We were prepared to obtain the spectrum of the tips of the cusps with the Bruce spectrograph on the 40-inch telescope, using one prism centered at λ 4500. We expected to use four different kinds of plates: Eastman 40, Panchromatic, Lantern Slide, and Process. This was to be operated by Mr. Struve, making visual observations and exposures, while Mr. Sullivan set the slit at the proper points on the cusps, according to the pre-arranged program, while Mrs. Lee kept time, took notes and read off the program for the successive exposures.

At the 12-inch telescope, the Yerkes spectrograph, with three prisms, had been so altered that it could be centered at λ 7200. Fresh kryptocyanin plates had been secured. This was to be operated by Mr. Barrett, assisted by Mr. Bobrovnikoff.

At the 24-inch reflector, Mr. Van Biesbroeck was to use a focal plane shutter for direct photographs of the partial phases. Kryptocyanin plates were to be used on the bare chance that a trace of the corona might be caught. Carried on the mounting was the small concave grating which we used at other eclipses: this was to be operated by Miss Calvert, and we used films bathed in dicyanin, and for the region of λ 7600 a kryptocyanin plate was set tangent to the curve. This concave grating has a radius of 60 inches, hence a focus of 30 inches.

At the Zeiss U.-V., Mr. Vanderlinden and Mr. Ridell were intending to take eight or more pictures in the violet, the 30° prism and 15° prism being used in combination.

Edwin B. Frost.

At Cincinnati Observatory.

At Cincinnati, the sky was clear except a thin streak of clouds near the planets, and the sun was already notched as it rose at 6:52. The maximum phase occurred at 7:57, when 0.91 of the diameter was covered; then Venus was visible to the naked eye and Jupiter could be seen with opera glasses; Mercury and the brighter stars were invisible. Dr. Elliott Smith obtained a number of photographs of the partially eclipsed sun with the 9-inch Cooke lens, and with a Century camera he obtained a set of images on the same plate at ten minute intervals. The last contact was observed by Prof. J. G. Porter at $9^h\,09^m\,41^s$, using the 4-inch Clark telescope; with the 16-inch, I caught it at $9^h\,09^m\,40^s$. The computed time was $9^h\,09^m\,39^s$.

Everett I. Yowell.

At Baldwin-Wallace College, Berea, Ohio.

Among the many groups that observed the eclipse of Saturday, Jan. 24, 1925, was the one at Baldwin-Wallace College, Berea, Ohio. This group consisted of about forty students, under the direction of Miss Pauline Chaffee, Student Assistant in Astronomy.

First reports indicated that no stars were visible during the eclipse but this group would most emphatically contradict that statement.

First contact was observed five seconds after the scheduled time, that is, at

7:55:05 A. M. At 8:55 Venus was plainly discernible to the west of the sun. At 9:01 Jupiter could also be seen, further to the west. Both of these planets appeared as bright stars when observed with the naked eye. When observed with the telescope Venus could be seen in its crescent phase.

By this time it had become quite dark and long shadows of a purplish shade were cast over the snow. When the sun's rays were allowed to pass through an ordinary broom hundreds of crescents could be seen on the wall of the Observatory. When the telescopic image of the sun was reflected upon a white paper the inner edge of the crescent was a deep purple.

Baily's Beads are only supposed to be visible immediately before and after a total eclipse of the sun. While the eclipse was only 97 per cent total at Berea, this group saw what they believe to be Baily's Beads. At 9:03 bright streaks of light radiated from the sun's surface, especially from the eclipsed portion. These lasted for about two minutes. They could be seen with the naked eye and were very bright when observed with binoculars.

At 9:05 Jupiter disappeared from view and at 9:16 Venus could no longer be seen. After the disappearance of the bright streaks of light the moon gradually passed over the sun and last contact was observed at 10:16:58 A. M. This was only two seconds earlier than the scheduled time.

At Buffalo and Niagara Falls.

Prof. and Mrs. O. L. Dustheimer and a number of B-W Students with about eighty members of the Cleveland Astronomical Society, which had two special cars chartered for the occasion from Cleveland to Buffalo, observed the eclipse at Niagara Falls, N. Y.

Part of the Society remained in Buffalo under the direction of Prof. J. J. Nassau of Case School of Applied Science, and the rest of the group observed the eclipse from the roof of the New Hotel Niagara at Niagara Falls, New York, under the direction of Pres. Dustheimer of Berea and Vice Pres. Schrader of Lakewood.

It was clear all night but at daybreak clouds began to cover the heavens. A few seconds before totality there was a break in the clouds through which a thin crescent of the sun could be observed. Streamers radiating from the sun in all directions could be seen through broken clouds.

The reflection of these streamers on the ice-covered Niagara River was a sight too wonderful to describe. A few seconds passed and it quickly became as dark as night. Twenty-four pictures were taken of these interesting phenomena.

Total darkness lasted about a minute and a half and then the rays from "Old Sol" lit up the sky. A few minutes after totality there was another break in the clouds and a thicker crescent could be seen. But during totality when the corona and prominences should have been visible a heavy cloud obscured the view.

At Ithaca, N. Y.

Having been to two total eclipses of the sun, 1918 at Green River, 1923 Catalina Island, and only getting a glimpse of totality through the clouds at Green River and absolutely nothing at Catalina, my hopes were not very high over this one, however I had a very definite idea as to what I thought I would see and what to look for if it should be clear.

Friday, Jan. 23, 1925, at Ithaca, N. Y., was cloudy and cold but just at sunset there appeared a clear streak in the west which somewhat dissipated our fears. Not much sleep for those scientists coming from far to get results; clear at 11:00 P. M., cloudy at 2:00 A. M., clear at 5:00 A. M.; up and dressing at 5:30 A. M., down in the breakfast room at 6:30 A. M. (the earliest possible moment to get a bite to eat, and that only by bribing the head waiter, cook and waiter). Off for Rockefeller Hall at 7:15. All this time clouds getting in the way, temperature felt like zero, as one colored gentleman said. Our feelings were way below by this time. Glancing out of our third-story window we saw the sun coming up clear, up went our hope-thermometer. On came the clouds from the west. At 8:30 A. M. looking out of a west window I saw a large break in the clouds, which intuition told me would just about reach the sun at totality. Fleeting clouds at first contact, as observed by Prof. Crump and myself; last cloud noted at 8:47; 8:55, clear; 8:59, clear. Must now stop noting clouds and attend to my various duties as assistant, such as reading voltmeter and ammeter, raising window and curtain, closing switch for lamp, and finally standing with heart palpitating for the word "go." Man foozled on starting time, cheer from crowd on campus gave cue. Started my counting in a very shaky voice, not heard by Prof. Crump till I said 30. I had recovered my voice and senses somewhat by now and raised my eyes to the sun. I was immediately calmed. There it was, not as I expected in color but a serene and calm scene, the sun and the moon simply obeying the laws of the universe. Majestic? Yes. Spectacular? No. Did I want to shout at this great movie being performed? No. In my thought I said, "It does move." My next "The heavens declare the glory and precision of God's universal laws." The moon was clean cut and intensely black. Just outside the blackness, extending entirely around the moon, was a narrow band of light resembling the color of pearls, and beyond this band, oyster-white streamers extending out on either side in the direction of the ecliptic, east and west. One streamer on the upper right hand side shooting out way beyond the others. As these thoughts and sights were passing before my mind's eye I was audibly counting seconds up to 104, when it was over. Still I find myself counting in my sleep and about my work, and still I see the on-coming moon and the calm white corona, which seemed to say to me "Why all this fuss, we are simply obeying the laws." Finally one look at the wavy shadow-bands on the snow, and it was over.

Williams Bay, Wis. ANNA G. PARKHURST.

AT SAUGERTIES, N. Y.

Excursions from Albany, Schenectady and Troy.
(Extract from a private letter.)

We were very fortunate in having fair weather conditions east of Buffalo and several million people saw the show. All our time during the week was taken up with preparations for special trains to run down into the path of totality from the Capitol district. The railroads would not take the initiative and so we had to handle all the receipts and issue tickets ourselves. Expecting possibly 300, we were swamped when 1600 people bought tickets before we closed our sale on Thursday night, and Friday we turned down a couple of hundred more. We ran three specials, one each from Schenectady, Troy and Albany, and the N. Y. Central ran another special after ours to take up the overflow of those deciding to go at the last minute.

The morning dawned clear, but clouded up after first contact and it was not

until nearly 9:00 o'clock that we got out from under the clouds. Then just at totality a thin veil spread over the sun. This however was not strong enough to affect our view of the corona, but may have been the reason why a streamer was apparently seen on the upper right limb, at some stations and not at others.

The shadow bands were visible at Saugerties, though weak. I got a great kick out of the corona and I know many people are just beginning to realize what they saw. It all happened so quickly that we did not really have a chance to see all we wanted to see. The clouds and the snow on the ground combined to make this a very light eclipse and where we were we missed the moon's shadow both coming and going. We saw two prominences; observations confirmed elsewhere. Venus, Jupiter and Mercury showed up very well and two of the brighter stars, but there was too much light for the others.

I think our crowd got the greatest thrill out of the end of totality. There appeared a small bright red spot on the upper limb, similar to Baily's Beads. This appeared to grow into a ball of red fire which seemed to envelop more and more of the moon. Just for a second it seemed to flow down over almost the whole moon and it looked as if the moon were burning up. The crowd was quite awe struck and there was a feeling as if the end of the world were coming. Then came the rim of yellow light which cut off the corona and the chromospheric light, and so far as we were concerned the eclipse was over. The view was all too short but I know I will never forget it and so far we have not heard of any who were disappointed in what they saw, in spite of the fact that most of our crowd had to get up at 5:00 A. M. with the thermometer at —10° F and wait until 7:50 for a train scheduled to leave at 7:15. We estimate that 2000 people went down to Saugerties to see the eclipse and that probably 75 per cent of the people of the Capitol district watched the partial eclipse.

Albany, New York. RALPH E. WILSON.

AT LEONIA, NEW JERSEY.

Eclipse observed from my observatory, lat. 40° 51′ 50″.5 N, long. 73° 59′ 19″ W. January 24, 1925. Morning clear as a bell, temperature 0° F.

Just before first contact, which was observed with a 2-inch refractor, sun was carefully examined for sun spots. None were found.

Times of contacts as observed are compared with those (enclosed) computed by Bessel's formulae.

First Contact	8^h	0^m	$7^s.4$;	late $32^s.5$
Second Contact	9	10	36.2;	late 14.4
Third Contact	9	11	20.1;	late 6.7
Fourth Contact	10	29	7.5;	early 5.5

Duration of Totality $43^s.9$, $7^s.7$ less than computed.

Second, Third and Fourth Contacts observed with 4-inch refractor, and watch error determined by Arlington (direct) wireless time signals at 8:40 A. M.

At time of totality Baily's Beads were distinctly seen, and one marked prominence about 200° east from Vertex.

Assistants saw shadow bands on snow covered ground. Described as thin waving pencil lines. Advancing shadow of the moon not seen.

A special camera was constructed with a 3¼ diameter, 13¾-inch focus photographic doublet lens, using Eastman Speedway plates and open lens.

During totality three exposures were made, 3, 8 and 15 seconds respectively, and one of 1 second at about the instant of reappearance of the sun. All plates appear to be good, giving images 0.14-inch in diameter. Four photographs during

the partial phase were made with a Graflex camera, exposure 1/110 second, and stop F/45.

Two stop watches were used to get times of the contacts, and watch error carefully noted.

Another observer in Leonia using a 3-inch telescope, and having correct time, differed approximately 0.1 second from the period of duration of totality observed by me.

Leonia, N. J., January 28, 1925. J. Ernest G. Yalden.

At Greenwich, Connecticut.

Point of observation, top of Round Hill, 5½ miles north of Greenwich, Connecticut.

It was a brilliant winter morning, a cloudless sky, a temperature around zero and not a breath of wind even on that bleak spot. Round Hill is identically what the north pole ought to be and is not: an enormous treeless mound with the land sloping away in every direction. One can see 70 miles of the Sound as well as 25 miles or so north and west. The snow crust was unbroken except in the immediate vicinity of where the little group of people stood.

Someone had brought a sheet and put it down about 10 minutes before totality. This reminded our lay minds of the fact that there were such things as shadow bands and from that moment my daughter and I watched that sheet carefully. Very soon there was a strange vibration of the shadows and within a couple of minutes definite wave fronts started moving across the sheet and moved from left to right as we stood with our backs to the sun. They were in a continuous stream and moved about 9 miles an hour, I should say. None of us noticed any change of temperature during the eclipse. It was so cold in the first place that two or three degrees one way or the other would not have been noticed. From the time the sheet was put down until totality I watched the shadow bands almost continuously and missed the coming of the shadow and Baily's Beads as a result.

As the minutes went on, the bands became more and more agitated. I do not know that the number of vibrations per second increased but the amplitude did, markedly, so that they overlapped towards the end and looked like several layers. Of course the whole field of snow was covered with them and the sheet simply served as a focusing point and one could get a better idea of their velocity by looking at the edges of the sheet. The amplitude when the wave fronts first became distinctly visible was about 6 or 8 inches but at the end it was 20 inches or so. I should judge that there were 3 or 4 vibrations per second. Just as they looked their very best, the individual shadow bands being about 1 to 2 inches in width (whereas each had started out a glimmering hair) the shadow was upon us and I turned around to realize that I had missed the beginning of totality.

After totality the lines started again almost immediately but they did not appear nearly as strong. They moved from left to right the same as before.

Greenwich, Conn. Nora Stanton Blatch.

At Stamford, Connecticut.

The day of the eclipse turned out to be an unusually clear day and also a cold one. About 9:00 A. M. the sky got a greenish blue in color and remained that way until 9:20 A. M. The temperature was observed to drop from +13° F at

8:30 A. M. to +12° at 9:00 and +10° at 9:25 but went up again shortly after.

Totality began at 9:10 and ended at 9:11 A. M., the duration being approximately 1^{m} 08^{s} at this station.

The shadow bands behaved unexpectedly, as in the places where the sun had formerly shone the brightest either no bands appeared or else they were very faint. In other words they were best observed in the shaded places. They were about six or eight inches apart and two inches wide and of a blackish tinge. They were visible for two or three minutes before totality. The board that I had intended to measure them on was placed in the full light of the sun and so had no visible bands on it. The shadows traveled from a direction slightly northwest to the southeast. The corona was roughly twice as bright as the full moon and extended for a distance of 250,000 miles from the sun's edge.

Stamford, Conn. H. SCOTT.

AT GUILFORD, CONNECTICUT.

I observed the eclipse of January 24, 1925, at Guilford, Conn., about 16 miles east of New Haven (Lat. 41° 17′ 09″ N, Long. 70° 40′ 57″ W). On account of the probability of bad weather no telescope was taken and we contented ourselves with field glasses and a camera. The sun rose behind dense clouds which covered the whole sky, and at 7:45 we decided that we would be unable to see anything, but soon afterward the clouds rapidly dispersed. The sun was visible through the clouds at first contact, but before second contact the sky was perfectly clear except for a small bank of clouds far off in the southwest. As we were unable to catch the time signals at 8:40 over the radio, we did not attempt to time the contacts, but from second to third contact was 121 seconds. The approaching shadow of the moon was not observed, probably because it came down from above. The shadow bands were very noticeable, but were not as sharply defined nor as definite as I remember those of the eclipse of May 28, 1900. At first they looked like the shivering of light passing through heated air, but they rapidly became wider and darker. They did not appear to be crescent shape as usually reported, but like waves, something of the shape of the curve of the sines. Their axis was at right angles to the path of the moon and their movement toward the coming shadow. They moved so rapidly that it was difficult to determine their shape or estimate their speed, but the movement was decidedly more rapid just before totality. The instant before second contact the faint crescent of light broke into the Baily Beads so beautifully as to bring a cry of appreciation from more than one observer. Then darkness fell but the snow covered ground kept it from getting very dark. However, Jupiter, Venus, Mercury, Vega, Alpha Aquilae and Epsilon Cygni were easily seen, and some other faint stars were visible but not identified. The corona was brighter than I expected and was a beautiful pearly gray shade, slightly tinged with green. It seemed to me that it extended more than twice as far east and west as it did north and south (directions refer to the axis of the sun, not the earth), but the photographs show very little difference. I also saw a peculiar curved horn upward and preceding from the northwest quadrant, but the photographs only show the base of this. I did not notice any polar streamers. Several rose colored prominences were seen with the field glass. The colors on the one cloud and around the horizon were most peculiar, reddish and bluish, but the time was too short to give them the attention they deserved. All too soon the light came back, and then for the first time we realized that the thermometer registered 3° below zero. We had been too thrilled to feel the cold.

It was a wonderful and impressive sight and well worth going a long way to see. The wonderful coloring of the sky and clouds and horizon, the weird tints on snow and buildings, and the eerie hue of the corona itself, are things that can never be forgotten.

Wayne, Pa., Feb. 6, 1925. HENRY G. BLATCHLEY.

AT JEWETT CITY, CONNECTICUT.

The total solar eclipse of today, January 24, was viewed by us from the grade crossing bridge over the tracks of the New York, New Haven & Hartford Railroad just north of Jewett City, Connecticut, approximately longitude 72° west and latitude 41° 38′ north.

Here the total phase lasted well over a minute. Ten minutes before totality the thin film of cloud we were so anxiously watching began to pass away, but before it left the face of the rapidly diminishing sun one of the loveliest sights of the whole celestial event was seen. A rainbow-hued band resembling the solar spectrum, with straight, diffused edges running perpendicular to the horizon, the bars of colors parallel to the horizon, and outlined with a brilliant halo of light, appeared about 15° to the right and slightly lower than the lower limb of the moon. This spectrum seemed to come from beneath the cloud and was seen through it; it lasted for about thirty seconds—then the sun and moon rode out into the clear blue above.

Five minutes before totality Mercury, Venus and Jupiter shone forth, dazzling points of silver light against a cobalt sky.

Two minutes before the total phase shadow bands were seen racing over the snowy crust with great rapidity. At the moment of the sun's disappearance the moon's shadow fell with incredible speed apparently from out the sky itself, since no path was seen on the western hills. Instantly the corona showed forth. It appeared in the shape of a four-pointed star, its streamers longer to the right, its inner ring glowing with a strange, iridescent light against the dark ball of the moon.

With the binoculars the chromosphere could be seen, a brilliant, burning band against the white shining of the corona. All around the horizon we could see the indescribable glow of the golden light filtering in from the sunshine-flooded world outside the shadow. Only one moment this lasted—a wonderful moment, never to be forgotten—and then the diamond-bright edge of the sun pushed out from behind the black disk of the moon.

It was over—but we felt indeed that "The Glory of the Lord shone round about"!

HELEN MAROT TAYLOR.

AT WESTERLY, RHODE ISLAND.

(From a Harvard student to his brother at Carleton.)

The trip surely was well worth the time, the inconvenience and the money. We got up at 4:00 A. M. (we meaning Truesdale and myself). At 5:45 we were pulling out of South Station on one of the twelve extra trains that took the crowd to Westerly, Rhode Island, and New London, Connecticut. At eight o'clock the train was pulling into Westerly. Just before we arrived we were able to see the beginning of the eclipse, but we were fearful lest clouds would ruin the "show of the ages." At Westerly the Board of Trade furnished trucks and automobiles to take us free of charge to the point of vantage. My but it was cold! We had dressed extra warm but still that did not keep our feet, hands and ears from

feeling the cold. About 15 minutes before the eclipse became total the clouds dispersed and we were left with a perfectly clear sky. It was interesting to look at the sun through old negatives as the moon steadily covered it. But no one would be able to give the exact description of what happened at the time of totality. Previously things had begun to look weird on account of the growing dusk. Suddenly instead of seeing a sight similar to a quarter moon, there was an intense white light and then the corona appeared. It was a sudden transfer from a bright light coming from a crescent to a dark object with small rays of light shooting out on all sides. At that time the stars were very plain, the clouds took on an appearance quite similar to that of morning or evening, in that they were crimson and then a soft violet hue. You could see the "shadow bands" on the snow, giving much the same appearance as do heat waves that you can sometimes see coming off a radiator or stove. Everyone was almost awestruck. I noticed a bird that was flying above the crowd. It seemed quite excited, for it flew in a circle just a few feet above the heads of the onlookers. Really, it was wonderful to look up and see the corona, and then, just as suddenly as it came, the round disk disappeared and once more things became light. Just as the sun emerged from behind the moon there was an intense white light very similar to what would be termed a white steel light. It was all over. People began to run to the road where the cars were waiting to take us back to the station. Everywhere you could hear people say that they would not have missed the sight for anything. There is as much difference in seeing a total eclipse in comparison with a partial eclipse as there is in seeing the sun itself and the sun as it is partially eclipsed.

W. Stewart MacDonald.

At Mt. Beacon, N. Y.

A Rainbow Phenomenon.—During the total eclipse of the sun on January 24, which I saw under most favorable atmospheric conditions from the top of Mt. Beacon, nearly in the center line of totality, I observed some peculiar and beautiful rainbow effects over the horizon: Lowest a glowing red band, then a faint orange, a still fainter yellow and then a very vivid green streak, quite as glaring as the red and much stronger than the orange and yellow; above that a dull violet which gradually toned into the murky sky; quite different from the ordinary rainbow, where the orange and yellow appear stronger than the green.

The general explanation of the light phenomena on the horizon is that they are due to light from the sky outside the zone of totality filtering in. It seems to me however that this explanation is not quite adequate, as it cannot account for the reversal of the strength of the various colors.

I should imagine that ordinary reflected sunlight filtering in from outside coming in contact with light rays from the eclipsed sun is broken by it so to speak. Now the light emitted from the totally eclipsed sun on January 24 was almost entirely corona light rays, as the prominences were very faint compared with the radiance of the corona. I therefore believe that what I observed on the horizon was in fact a mixture of an ordinary sun spectrum and the spectrum of the corona, or rather a faint sun spectrum intermingled with or overlaid by a strong corona spectrum.

That I think would account for the phenomenon as well in its optical as in its physical aspects.

New York, Feb. 7, 1925. P. M. Adler.

(To be continued.)